MAY 5 - 1924

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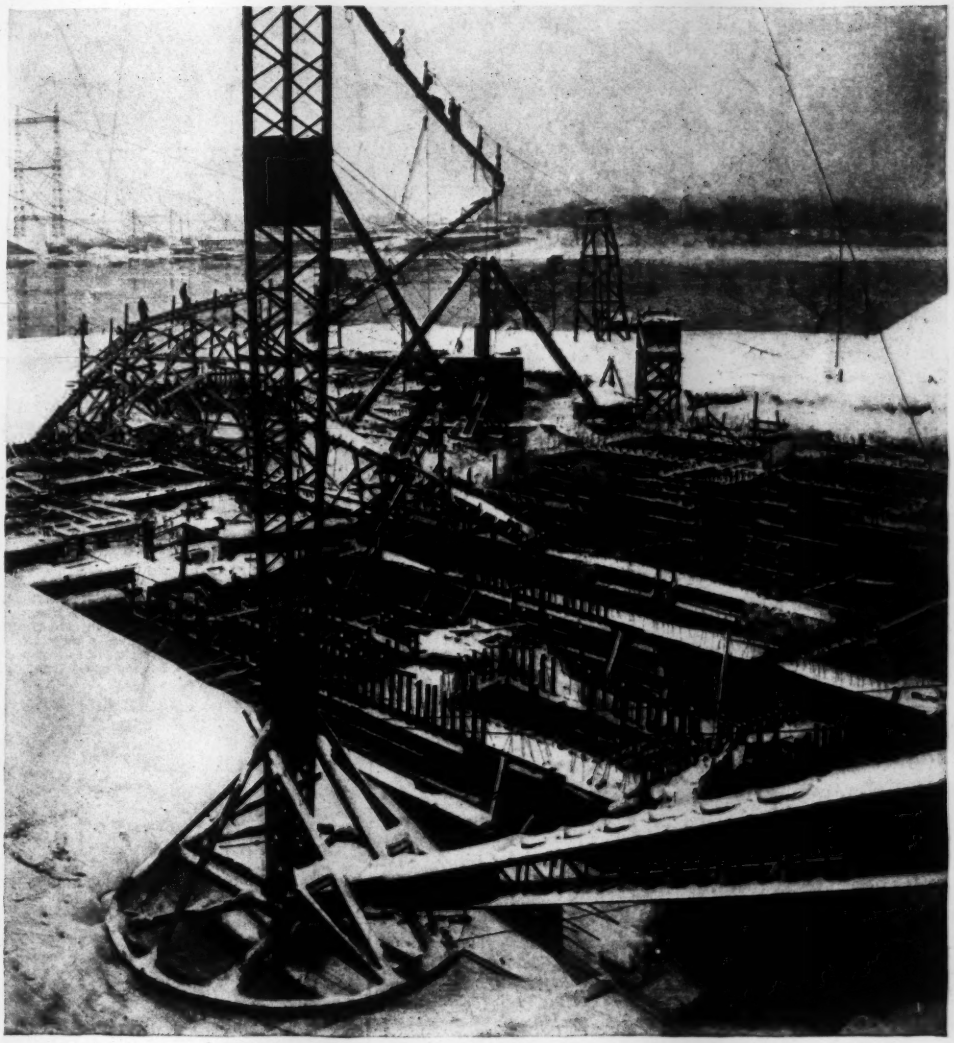
May 1, 1924

Engineering News-Record



Winter Work on Devon Power Station on the Housatonic River

Alleviation and Remedy of Street Congestion

Construction Procedure for a Steam Power Station

How a River Control District is Building Its Reservoir

Six Pages of Job and Office Hints

Engineering News-Record Construction Cost and Volume Index Numbers; and Monthly Prices of Construction Materials

No other roof can be *Worth* as much

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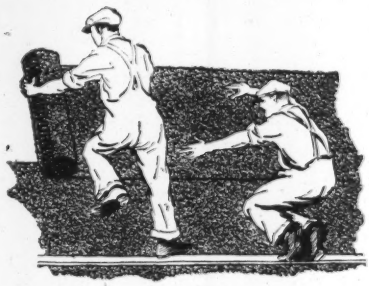

The composition covered wood roof—

This includes tar or asphalt and composition coverings. None of these roofs is fireproof—all require periodic recovering, painting and frequent repairs—all are short lived and greatly increase insurance rates. Half of all fires start or spread on the wood roof—and fire insurance does not cover interrupted production.

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A Consolidation of Engineering News, Engineering Record and The Contractor

ENGINEERING NEWS-RECORD

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DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

FRANK C. WIGHT
Editor

Volume 92 NEW YORK, MAY 1, 1924 Number 18

Ford's Chances Waning

THE hearings on Muscle Shoals before the Senate Committee the past weeks have not revealed anything new to those who have made themselves acquainted with the details of the various offers for the government's enormous development on the Tennessee but they have materially changed the prospects of the disposition of the project. For years the Ford offer for Muscle Shoals has been moving toward what appeared at times to be acceptance on a wave of manufactured fervor. The sentiment of the entire South was made a plaything of the real-estate interests of the three towns that surround Muscle Shoals and the farmers from coast to coast were confounded by a delusion of cheap fertilizer. Facts about the Ford offer were confined to those technical sources which do not reach the people, who were persuaded that somehow some way they were to be benefited by the government's giving away this inestimable resource to Henry Ford. But the Senate hearing has at last brought the facts before the public and Mr. Ford's chances to get Muscle Shoals are rapidly fading in the face of the obvious unfairness of his offer and the obvious superiority of either of the two major competitive offers.

More Study Needed

THE fact is that Congress cannot honestly determine the relative merits of the various Muscle Shoals offers at the present time. It can kill the Ford offer—or at least force a resubmittal of that offer so that it will be a fair bargain to the government and an insurance against monopoly control. But the other major offers are so incomparable that to accept either one without further consideration would be injudicious. The Low committee of Engineering Council, which reported this week as noted in our news pages, is quite sound in its recommendations. So far as power is concerned the Federal Power Act should govern, and the process of leasing need not be made abnormal or special in any way. It is the fertilizer manufacture which is doubtful and Congress is now in no way fitted to get the facts as to that. Only a special technical investigation by unprejudiced engineers and chemists will furnish the basis on which the legislators can make a fair judgment. So far the whole consideration of Congress has been devoted to partisan defenders of the various offers. It needs some technical advisors to differentiate between these claims.

Small-City Traffic

TRAFFIC congestion presses even harder for immediate consideration in cities under 500,000 population than it does in those which count their people in millions. This paradox is explained by the fact that these smaller cities generally still possess the areas, at comparatively reasonable cost, to provide increased traffic space and can save rapidly mounting costs by planning immediately to capitalize their advantage. Again many small cities have a larger motor vehicle census per unit of city area than do cities of the first magnitude. Such small communities are Dayton, Reading, Dallas, Toledo, Akron, Rochester and Bridgeport. In these cities and others the problem of providing for future traffic increase is easier and cheaper to solve now than it will be at any time which is coming. No one can doubt that traffic will increase. By intelligent action the smaller cities can do much to keep the problem of traffic congestion far from the nearly unsolvable character it has attained in the big cities. Will they do this or wait until the tangle of traffic will cost enormous sums to straighten out?

Four-Track Highways

AN 18-FT. pavement has been regarded good practice for main roads. It gives reasonable room for two lines of traffic. Borrowing a term from the railways it is a two-track pavement. Now the two-track pavement in places is growing inadequate and, to continue the railway parallel, need is being found, as long ago the railways found need, of making some roads four-track roads. Two notable instances are the Boston Post Road in Connecticut and the Detroit-Pontiac highway in Michigan. Both of these highways began their paved-road life as two-track thoroughfares—the Boston Post Road 18 ft., and the Detroit-Pontiac road 16 ft. wide. A decade perhaps covers the hard pavement history of both. It is proposed to make the Boston Post Road 36 ft. wide; indeed parts of the road are now in process of construction to this width. On the Detroit-Pontiac road, about 31 miles, the planned construction consists of parallel 40-ft. pavements separated by an electric railway. The Michigan road is a rather special thoroughfare, virtually a driveway between the automobile factories of Detroit and those of Pontiac and Flint, with a daily traffic of 5,000 automobiles and 15,000 motor trucks. On the contrary the Boston Post Road is a true general-traffic trunk line; its widening is demanded by a heavy and increasing, diversified-industrial traffic. As such it typifies conditions which are coming about in many sections of the eastern seaboard states and which are bringing to highway engineers the problem of four- and six-track road design. Connecticut's solution was a single-strip 36-ft. pavement.

Construction-Site Development

DEVELOPMENT of site is a task which progressive contractors find to be well worth full consideration. As used by the contractor, the term means fitting the ground for easy, convenient and cheap construction. The men in the field call it "getting set" for work. It is a separate problem from economic engineering location of site, although this involves economical construction among other requirements of good engineering

direction. Specifically, development of site for construction includes provision of access; provision for maintaining working forces; provision of service plant and construction equipment; removing hindrances like overflow, ground water and overgrowth, and salvaging available materials as sand, gravel, and stone. An example of practice is had in the construction of the Devon power station described in this issue. Here the site was most thoroughly developed for construction. There was not a hitch because access was lacking or because the men were not cared for, or because shop service was wanting or equipment was not provided, or because overflow or ground water interfered. There was planned development of the sand beds for concrete. Good management in other respects contributed materially, but the outstanding reason for success beyond ordinary was making all things ready before beginning actual building. There were other items of construction interest—winter concreting was one and extensive job-shop fabrication was one—but the high point of construction management was full development of the site for construction.

Road Mileage and Profits

MILEAGE constructed is the accepted gage of prosperity in the highway industry. This is natural and logical. Yet there is a measurable difference between road construction expenditure and activity in road construction. All other conditions, except materials prices and wages, being assumed equal, a hundred thousand dollars would construct 2.9 miles of paved road in 1919, 2.4 miles in 1920, 2.6 miles in 1921, 3.3 miles in 1922 and 3 miles in 1923. The figures are those of the Bureau of Public Roads. Which were the better conditions for the highway industry, those of 1922 or those of 1920? The answer is by no means obvious; indeed the problem is complex with a multitude of factors. Road builders received more money for the amount of work they did in 1920 than they received in 1922, yet it is common knowledge that 1920 was a particularly disastrous year for highway contractors and 1922 was one of their most prosperous years. The point is that on the face of any statistics offered, no conclusion is sound except that it is hazardous to draw conclusions.

Dumping Money Into Hudson Bay

DETERMINED to have the Canadian Government complete the Hudson Bay Railway and the terminal facilities at Port Nelson a large delegation from the prairie provinces is again in Ottawa sounding the praises of the Hudson Bay route to Europe and demanding that this new outlet for western grain be made available at the earliest date possible. The battle which raged previous to the start of the construction of the railway in 1910 is being fought over again in Ottawa, but this time the proponents of the scheme are reinforcing the arguments with which they convinced the government of that earlier date of the feasibility of the route by the plea that the present government must safeguard the $20,500,000 already spent on the railway and the port by putting both in working condition. To do this will require $6,250,000 for the railway, to complete the last 11 miles of grading, lay track on 92 miles, and put the remaining 332 miles in safe operating condition; and $20,500,000 for the completion of the harbor works at Port Nelson, a total of $26,750,000 for new work.

Added to what has already been spent this would bring the cost of the project up to nearly $50,000,000—and all for what purpose? For the construction of 424 miles of railway through a section of country a large part of which is semi-arctic in character covered with muskeg and scrub spruce—to reach a port on a tidal estuary where the natural advantages are so poor that at the present time supply ships have to anchor 7½ miles off shore and send their supplies in on shallow boats—on a bay whose only outlet is through a tortuous and largely uncharted strait close to the arctic circle and which is safely navigable only from the latter part of July to the first of November. All this to eliminate the water and rail haul of western grain from Ft. William at the head of navigation on the Great Lakes to Montreal, in summer, and the rail haul from Ft. William to St. John, N. B., in winter; or if grain cannot be economically stored at Port Nelson then only the water and rail haul from Ft. William to Montreal in summer.

The facts that Montreal and Port Nelson are about equally distant from England, and that Ft. William and Port Nelson are about equally distant from the center of the grain-raising district, make the Hudson Bay route look attractive to one who does not know or will not recognize the difficulties; but the Canadian Government has frequently been warned of these difficulties and of the impractical features of the route, and until it can be proved by careful scientific study that the route can be operated more cheaply than the present routes and that the loss to the government through the diversion of grain traffic from the present routes will be offset by the economies of the new one then any further expenditures upon it will be money thrown away.

A Makeshift Immigration Law

THE new immigration bill which will go the President for approval as soon as the House and Senate can agree on the number of relatives of earlier immigrants to admit outside the quota is essentially a makeshift and a subterfuge. Leaving aside the disagreeable Japanese exclusion amendment, which was a needless complication that could have been settled better by diplomatic negotiation, the immigration act which will go into effect next July—provided the President does not impose a veto—tries to do one thing by saying quite another thing. The obvious purpose of the act is to keep out of the country those prospective residents whose views, morals and habits of life are considered most incompatible with those of the generality of our people. No one, however, is able to define exactly these undesirable qualities or to provide criteria for judging them. The assumption therefore is made, on more or less vague anthropologic and sociologic grounds, that those possessing them are of certain races and habitats. But international comity forbids specifying them by race or habitat, so resort is made to a quota restriction based on the racial and natal character of our people thirty-five years ago, the census of that period showing that today's undesired peoples were only negligibly represented here at that time.

This is beating the devil around the bush. Doubtless

it will be successful in keeping out a number of undesirables but it keeps them out on an irrational basis and at the same time does nothing to encourage the kind of immigration that the country needs. Calamity howlers to the contrary notwithstanding the day has hardly come when this country can assimilate no more. We are far from crowded or overpopulated. Let any one forget statistics and merely look out of a car window for an hour anywhere in this empty land of ours. There is still room for many millions—but there is not room everywhere. The great city's slums flow over already, but the factories of the smaller and roomier cities and the farms and the construction jobs cry out for men.

The solution of the immigration difficulty lies in selection, not by race or source, but by trade and inclination. We need no more clothing workers who make some of New York's streets an abomination, but we need truck farmers and bricklayers and ditch diggers. If the new immigration law insured the distribution of new blood to the needed fields it would be more promising, but it will not. All that it can do is to keep out some individuals whose racial characteristics are undesirable. It will not give us men for the jobs that our native youth are becoming more and more reluctant to take.

If organized labor—with its complete exclusion ideals—were not so strong in Congress, we would have an immigration law which permitted selection on the basis of demand. We would have a scientific analysis of the kind of people we lack and a systematic search for those kinds overseas. And when they were found and persuaded to emigrate they would be directed to the localities that both needed and wanted them. And we would find that the second generation of those needed people, educated and trained in the American atmosphere, would be indistinguishable and the bugaboo of race would be made ridiculous.

But so rational a scheme of selection is impossible, it appears, and we must worry along on the makeshift that Congress provides. Time only can tell how it will work—and a long time at that. But one thing can be counted on. As long as the new law is in force the cost of construction is not going to fall, and the wages of common labor will continue to rise.

Better Building

ONE of the oldest of public problems, good building, seems to have entered into a new period of serious attention. Engineers and architects have come to recognize that they are jointly concerned, and that the professional relation to the subject is paramount. This was exemplified by a joint meeting held in New York last fall, and more recently by a similar meeting in St. Louis, independent of the other. In quite different surroundings, better building practice was discussed actively by the Building Officials Conference at its Louisville meeting two weeks ago (see April 24 issue, p. 732). And, to note a further distinct activity, revision of building codes is going on in dozens of cities throughout the country, though this phase of the movement began some years ago. Such manysided attack on the building problems is hopeful, and promises real progress.

The various activities noted might suggest that building as a whole is unsound. No such conclusion is warranted. All but a small amount of building work is done safely and well; but that small part constitutes an everpresent public menace and supplies the motive for reforming our method of procedure. Carelessness, lack of conscientious responsibility, ignorance and incompetence are factors in this bad building. They are difficult to deal with at all times, but in the modern period their influence has increased steadily, in step with the severer demands of present-day building and the spread of complex types of structure. The present movement for better building is therefore timely.

Necessarily the problem is first of all a professional one. Modern building centers around structural matters that are outside the field of the craftsman and are the special province of architect and engineer. It should be within the power of these two professions to safeguard building to the fullest extent. Yet in the past they have not done so, as recurring failures in building work showed. For this reason the most interesting feature of the present situation is the work of an interprofessional committee formed after the abovementioned New York meeting, in which committee architects and engineers worked together to produce specific recommendations for improving building practice. Their report (see April 10 issue, p. 615) outlines the proper functions and responsibilities of the professional man in building construction. It expresses the basic principle that safety in building depends essentially on the exercise of technical competence and skill—the professional function. This is inspiring doctrine, and until building laws recognize its truth they will be vain attempts to supply through public agency that assurance of good building which can be given only by those who are directly engaged in carrying out the work.

Thus the present movement, if maintained, will lead on to making private responsibility effective, and this is decided progress. At the same time, however, progress is being made in the equally necessary work of improving building supervision. Its most hopeful feature is the gradual elevation of the office of the municipal building superintendent to a recognized technical plane. This change is reflected in the career of the Building Officials Conference, a young and struggling society which seems at last to have reached sufficient strength of membership and clearness of purpose to assure its permanent usefulness. The Louisville meeting gave proof of this welcome condition.

Not many years back, it was the exception rather than the rule to find a technical man as head of a municipal building department; today, most municipalities seek competent men for these positions, men conversant with structural engineering principles as well as with the methods and practices of building construction. Even today, however, more attention is given to building codes than to building officials, though the building official is the more important of the two. A poor building law administered by a capable official will result in much better building than a good law administered by an incapable official. Improvement in the grade of building officials, and their own efforts toward progress by joint discussion of their building problems are important factors in the improvement of building. The interests of architect, engineer, and building official are interlocked so far as this problem is concerned, and the most effective result may ultimately be reached by the fullest co-operation of the three classes in working for safe building.

Construction Procedure For a Steam Power Station

Connecticut Light & Power Co. Completes 75,000 Kva. Unit at Devon—Concreting Continued Through Winter—Many Parts Fabricated in Field Shops

CONSTRUCTION on the Devon steam power plant, just completed by the Connecticut Light & Power Co. on the Housatonic River a few miles east of Bridgeport, was characterized by a well developed attack. Its essential parts were (1) careful development of the site for construction operations; (2) adequate provision of construction plant including equipment, camps, shops and transportation; (3) close scheduling of operations and co-ordination of participating building trades. The effect was notable. With great possibilities of complication by ground water and overflow and with a heavy winter work schedule, construction operations were virtually devoid of any but ordinarily vexatious incidents.

Structurally the construction comprised: a boiler house 130x98 ft., five stories high, with two 347-ft. stacks; a turbine room 253x57 ft. of four stories; a control house 40x27 ft. All buildings have steel frames, brick and tile walls and heavy concrete foundations. Incidental construction comprised a coal storage trestle, intake and discharge channels, an out-door bus-bar structure, and railway tracks to the main buildings. In brief the work was a typical steam-electric power station job with respect to structures and accessories.

Development of Site—As affecting the constructor, the significant characteristic of the site was that it was an irregular bottom bordering a tidal river. The contours on Fig. 1 indicate the conditions. Specifically, the site was a swamp with knolls and ridges of high ground having growths of bushes and trees. High-tide, flood-season conditions in the river caused overflow of some areas and, all over the site, brought the water table near surface level. Naturally groundwater was a construction contingency to be carefully prepared for. Equally imminent was the problem of access—traversing roads and tracks were also a contingency of construction. And finally the location was enough out of the regular way of existing residence accommodations to make living quarters on the work, particularly for common labor, virtually a construction contingency.

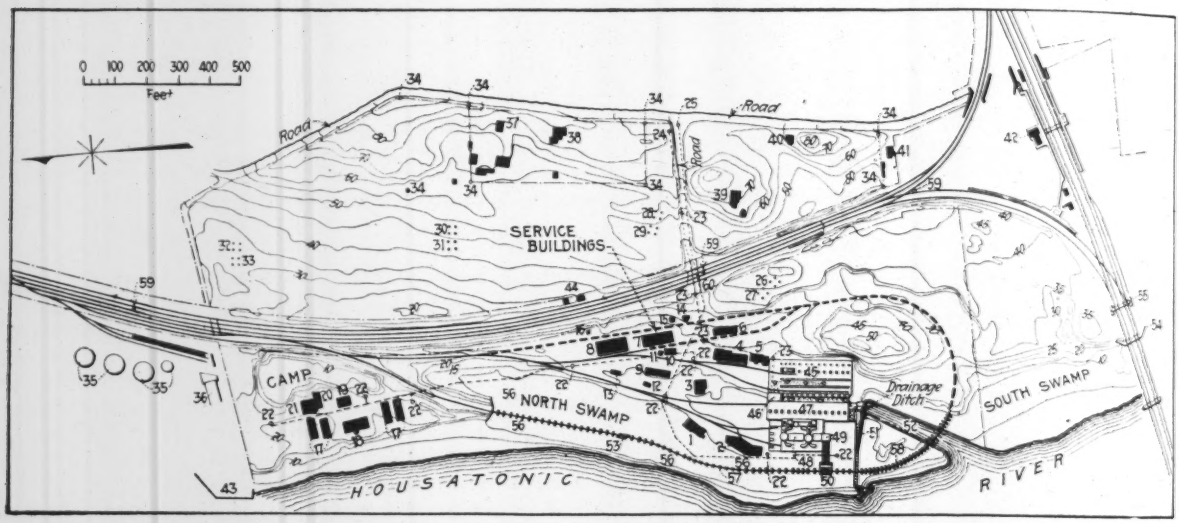


FIG. 1—CONSTRUCTION PLANT LAYOUT, DEVON POWER STATION

1 Field office
2 Brick shed and pipe fitter's shop
3 Carpenter's shop
4 Cement shed
5 Concrete mixer
6 Garage
7 Machine shop
8 Store house
9 Electrician's shop
10 Brick masons' shed
11 Compressor tank shed
12 Oil house
13 Store house
14 Transformer house
15 Blacksmith shop
16 Reinforcing shed
17 Bunk house
18 Mess hall
19 Wash house
20 General store
21 Italian mess hall
22 Fire hydrant
23 Telephone manhole
24 Telephone pole
25 City water manhole and meter
26-33 Transmission towers
34 Monument
35-36 Gulf Refining Co. storage tanks and office
37-41 Dwellings
42 Devon station, N. Y., N. H. & H. R.R.
43 Gulf Refining Co. docks
44 N. Y., N. H. & H. R.R. buildings
45 Outdoor substation
46 Control house
47 Turbine house
48 Boiler house
49 Coal tower
50 Coal hopper and crushers
51 Intake canal
52 Discharge canal
53 Future intake crossing
54 Abutment, N. Y., N. H. & H. R.R. bridge
55 N. Y., N. H. & H. transmission tower
56 Coal storage area
57 Concrete and steel coal trestle
58 Wooden trestle
59 N. Y., N. H. & H. monument
60 Private crossing

Development began at once and simultaneously along all of the three directions indicated. Procedure was about as follows: From the ridge a road was brought downhill and across the tracks to the construction site and a corduroy road was built across the north swamp to connect the group of camp buildings with the group of service buildings farther south. On the camp site an Italian bunk house and mess hall were built first and followed by three two-story bunk houses for mechanics and foremen. A company mess hall, a wash house and a commissary store were added. These buildings gave room comfortably for 200 men. Water was piped from a nearby spring and fire and hydrant lines established as indicated on the map Fig. 1, when, later, the service building group was installed.

The next step was to get access by railway. A siding was brought in from the north and through the group of service buildings. Later this was forked out into the spurs reaching the permanent buildings as shown by Fig 1. The coal yard track was a later structure. The siding embankment was cast up by a steam shovel on crawler traction, the borrow being also planned to strip the muck and gravel and uncover a bed of sand wanted

later for concrete work. These switch lines brought in virtually all of the construction material used after their completion except camp and other building material.

Along with camp building and providing roads and tracks, clearing the site was going on. A more important task was test pitting to disclose the soil and water conditions. Except on the knolls, the top soil was swamp muck under which were gravel and sand layers in various arrangements and combinations. Test pitting was done chiefly on the permanent building sites, and in the adjacent south swamp. The water conditions showed drainage to be necessary for the building foundation pit excavation. A drainage ditch was located, as shown by Fig. 1 and in enlarged detail by Fig. 3, about a hundred feet south of the power house site.

As indicated by the drawing, the drainage ditch was more precisely a cutoff trench with a sump about mid-length and another at the west end. The trench was 16 ft. deep, with sheeted sides, and the sumps were bottomed at a level about 5 ft lower than the bottom of the deepest foundation which was at —21 ft. elevation. Two 6-in. electric pumps, with a stand-by steam pump at the middle sump handled the water. Indeed, the flow developed, with the river only a stone's throw away, was remarkably moderate. The reasons for this are not plain but in any event the foundation pits 21 ft. below mean water level in the river were virtually bone dry. Fig. 4 is a part view of one of the foundations showing the standing banks of the pit. The drainage ditch accomplished its purpose.

This development of the site, as described, for construction deserves emphasis. First were the camp provisions for holding workmen on the job; second was the development of means of access, and third was the drainage of the foundation site. Together they exemplify nicely a fundamental of good construction management—the development of conditions favorable to construction operations.

Development of Service Plant—With the development of the site as described there was carried on the creation of a service plant consisting of a group of structures located on the high ground adjacent to the power station and designated in Fig. 1. Notable in this outfit are the number and variety of shops—carpenter, machine, electrical, pipe fitters', riggers' and blacksmith. This was in accordance with a policy laid down by the contractor of job production in unusual volume of materials and parts entering into the construction processes and the structures. The service plant was in a notable measure a manufacturing plant. Most prominent in this work were the carpenter, electrical and machine shops and in a more usual way the concreting plant.

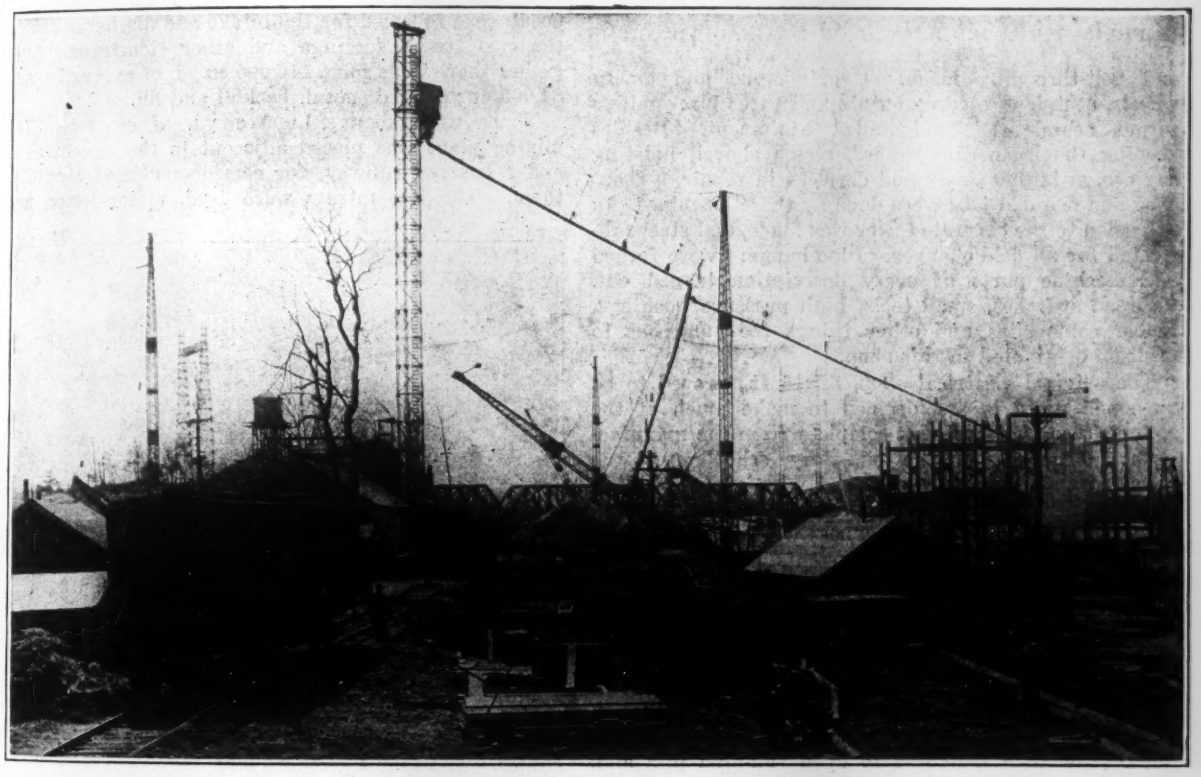


FIG. 2—GENERAL VIEW OF CONSTRUCTION PLANT FOR CONCRETING AND ERECTION

Manufacturing required stock, and storage was provided in a building with 4,000 sq.ft. of floor space. Besides the forms which were extensive for walls, and piers and which were all made up in panels or sections as shown by Fig. 5, all framed work for the intake and discharge gates and other structures was turned out at the carpenter shop. Similarly the blacksmith shop did more than the usual small fabrication and repair work of a construction job. It was in the machine and electrical shops that fabrication was most fully developed.

The machine shop, in addition to its own complete equipment, contained a well stocked tool room. Here, in stormy weather, the men secured rubber boots and oil skins. The central compressor plant, composed of single and compound compressors, furnished air for all purposes. It drove over 200,000 rivets, supplied air for the pipe bending kerosene torches, and cleaned forms, pipes and floors. A 24-in. lathe, metal band saw, pipe

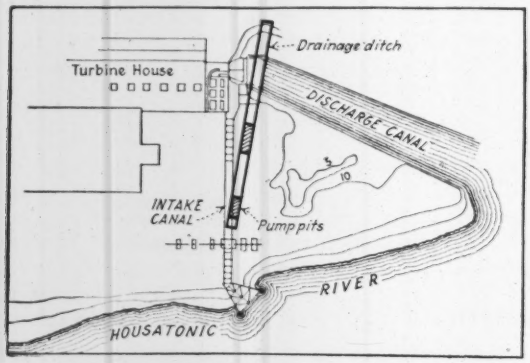


FIG. 3—ENLARGED SKETCH OF DRAINAGE DITCH

and bolt-threading machines, grindstone and emery wheels, acetylene welding outfits and three blacksmith's forges completed the installed equipment. Besides keeping the locomotive cranes, steam shovel, hoisting engines, swinging gears and derricks in repair, a thousand and one odd jobs were done by these machines. An extension to the concrete tower was made, and steel fabricated for all field changes. Pipe hangers were forged and machine parts of every description turned out. Railroad switches, small tools, high pressure bushings, copper cable clips and other things too numerous to mention originated in this shop.

The original electrical shop, 32x16 ft., proved to be too small when it was decided to make much of the material usually purchased complete from the manufacturer. A large portable one-story schoolhouse was procured and completely equipped with a pipe-bending machine, drills, stands and punches. All-blank switchboard panels were received. These were designed here, laid out, drilled and the instruments placed on them. Every junction and conduit box was made in this shop. All of the large copper lugs for the outdoor switching structure were also made here.

Development of Foundations—Other plant and equipment are better presented in connection with the construction operations which they more specifically served. Foundation development was the first of these operations. The plan here was to open full-area pits and, after the footings, pedestals and walls were in, to backfill back to nearly the original surface level. Most of the concrete work was very massive. It was built continuously with excavation. A section, about one power unit, of the foundation pit was opened and the 3-ft. reinforced-concrete mat laid on the bottom (Fig. 4). Then the pedestal forms (Fig. 5) were erected and poured, forms removed, and pit backfilled.

FIG. 4—FOUNDATION PITS PRACTICALLY DRY

Excavating equipment comprised chiefly two wooden stiff-legs with 70-ft booms, one steel guy derrick with a 100-ft. boom and a steam shovel. With clamshells, the derricks opened the pits and backfilled them later. Surplus spoil was piled, loaded by steam shovel into cars and generally hauled to the north swamp for grading. Practically like methods of excavation and disposal were followed for the intake and discharge canals, the coal trestle footings and other structures. Altogether there were some 116,000 cu.yd. of excavation and 84,000 cu.yd. of disposal, backfill and fill.

There were about 21,000 cu.yd. of concrete. The mixing plant was placed adjacent to the cement shed, and a covered runway, for cement carriage, connected them. The two mixers were 1-yd. motor-driven machines. The four aggregate bins above had a combined capacity of 212 cu.yd., and were filled by means of a wooden derrick. Most of the crushed stone was shipped in and unloaded near this derrick. All of the sand used, however, was excavated on the property. After the shovel had stripped the sand pit to make the siding embankment, it piled the sand where the crane could reach it. Dump cars hauled it to the mixing plant where it was screened and piled ready for use. This made a great saving in the ultimate cost of the concrete. The tower and high line were of sufficient height to pour the roof of the boiler house and had a reach of about 400 ft.

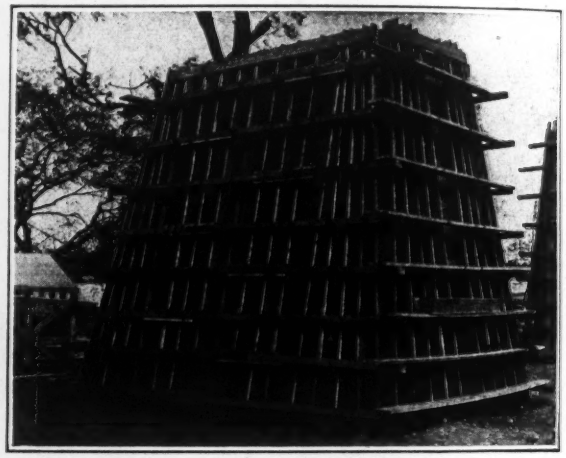


FIG. 5—PIER FORM HANDLED AS A UNIT

Practically all of the building foundation work was a winter operation. During the period several heavy snowfalls, as shown by Fig. 6, covered the work but its progress was never stopped. Precautions were of course taken in placing the concrete. It was placed warm by using heated mixing water and the forms were heated on the outside with steam coils, both forms and coils being covered on top and draped with canvas. The chutes had a good incline and the warm mix moved down them with no trouble. At night the tower hopper and chutes and other concrete containers were cleansed

with hot water. Absolutely no concrete was lost because of cold weather placing. To get this result, however, it has to be noted that while the processes were simple the care was infinite.

Outside of the building foundations and substructures the greatest volume of concreting was for the piers of the coal yard track. This construction was begun in April and cold weather precautions were unnecesary. The coal track is shown as completed by Fig. 1, which also indicates by broken line its future extension.

The first section was an earth embankment. The next section across the north swamp was filled above high water and surmounted by a concrete trestle. The last section was a wooden trestle. After the embankment had been made to the edge of the swamp, wooden bents were placed, rails laid, and the dump cars backed out and dumped. When the fill was completed a trench was dug by the steam shovel. The muck removed was replaced by good gravel. Then the forms for the footings were placed and the concrete poured. The piers quickly followed. These forms were built in sections so that they could be stripped, cleaned and used again. This operation necessitated a hopper at the end of the concrete chute, which emptied into another hopper on a flat car. This car ran on a track parallel to the piers and poured the concrete through a wooden spout to the desired spot. Steel girders connect these piers and support the track. This track is 20 ft. above the yard grade and allows coal to be received by rail and stored within easy reach. The coal storage area is sufficient to care for 50,000 tons. The south end of the trestle was composed of wooden bents set on concrete footings.

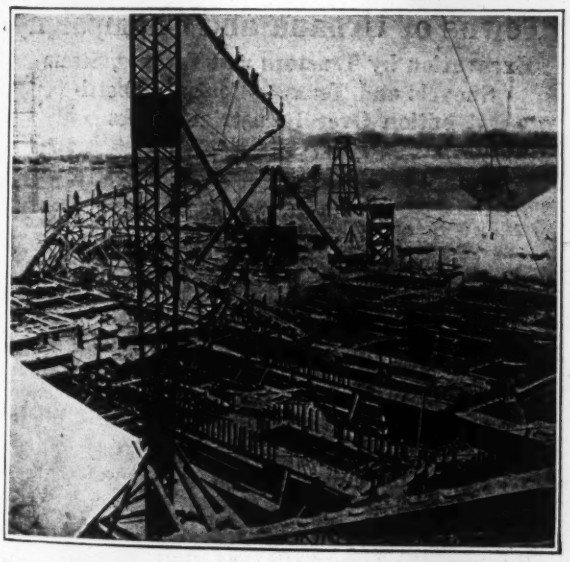


FIG. 6—CONCRETING CONTINUED THROUGHOUT WINTER

This section is used as a tail track and will eventually form part of a run-around track (see Fig. 1).

It has been stated that the trestle pier forms were fabricated in sections or framed panels. This was true of all formwork, of which there was some 315,000 surface feet. Throughout, the handling of forms was by power—derricks and locomotive crane—and moreover it was planned to handle large units. Some of the retaining wall panels were approximately 60x20 ft. In case of the foundation pedestals (Fig. 5) the entire form was handled as a unit. As a matter of record it should be stated perhaps that virtually all concrete was reinforced. In all there were about 858 tons of bar reinforcement and some 60,000 sq.ft. of mesh.

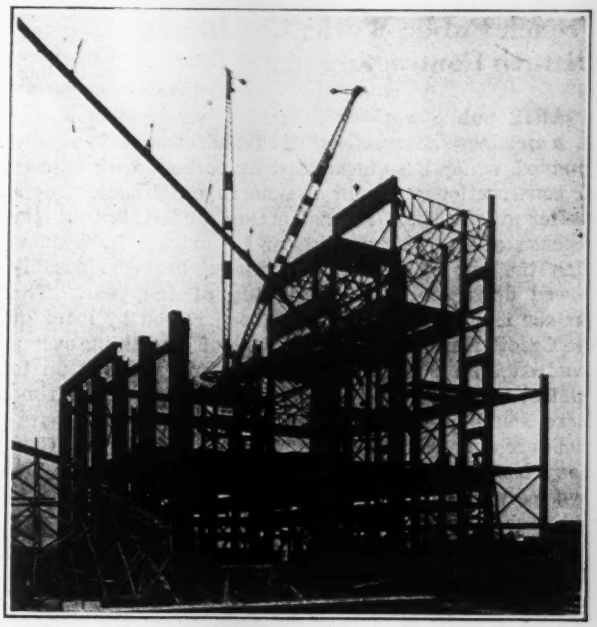


FIG. 7—STEEL AND STACKS ERECTED BY GUY DERRICKS

Development of Superstructure—Above the foundations, the work was straight-forward building construction, steel frame, brick and tile walls and concrete floors. The two stacks were of special construction, and there was of course the complex mechanical and electrical installation which is not a part of this article. The first steel of the boiler house was erected March 23, 1923, using a locomotive crane traveling on a track through the building. When the first story was up a steel derrick was raised to this level and from there erected the higher framework. In the turbine house steel erection, the same equipment was employed, supplemented by a Chicago boom attached to an upper column splice. Fig. 7 shows steel erection in progress. Altogether there were some 5,300 tons of structural steel work.

Stack erection began about the middle of July. The derrick on the roof picked the plates from the ground and raised them to position. When its reach was exceeded a float with a gin pole was placed in the stacks. The stacks, lined with radial brick, are 347 ft. high.

In the remaining building work there was no operation out of ordinary practice. In March, 1924, the clean-up started with the structure virtually finished. First work in developing the site began in August, 1922.

Personnel—The general contractor for the Devon Station was the J. A. P. Crisfield Contracting Co., a subsidiary of the U. G. I. Contracting Co., Philadelphia. H. J. Hoard was construction engineer for the contracting company. The design and construction were carried out under the engineering supervision of Paul Spencer, consulting engineer, and K. M. Irwin, his mechanical engineering assistant; Irvin W. Day, vice-president, and E. J. Amberg, electrical engineer of the Connecticut Light & Power Co. C. F. Hirshfield, Detroit, acted as advisory consulting engineer for the latter organization.

French Public Works Conditions Disturb Contractors

French Correspondence

PARIS public works contractors have protested the scandalous accusations of fraud, founded or unfounded, which have been recently current with respect to construction work in the north of France. As a matter of fact, all reconstruction undertaken at the expense of the government, or by private individuals with the aid of government funds, has considerably slowed down since the beginning of the year. The various moneys advanced have been raised by loans of the Credit Nationale, to the extent of something over a hundred billion francs and have been expended up to the last centime in the expectation that before this time there would have been payments by Germany on reparations account when these bonds could be retired. Germany has not paid and France is chary of asking her own people to advance any more cash; indeed it is doubtful if they could be counted upon to do so.

Payments have been made at the rate of 320,000,000 francs per month up to quite recently when the sum was reduced to 100,000,000 per month. This will bring about a certain amount of job-hunting on the part of those already employed, nearly 300,000 being employed by the various building trades in reconstruction alone. Some of these can be absorbed by the very considerable program of public works in Paris itself (set forth in *Engineering News-Record* of Feb. 14) but again a complication presents itself in the matter of finding lodgings for even an additional hundred thousand of such workers in the Paris district.

What more particularly concerns the contractors' association is how and when they are going to be paid for the work under way and already accepted for future completion in case the Credit Nationale finances will not allow immediate and continual payments on account as work progresses. Accordingly they have taken the attitude that a series of demands must be made of the government if the work is to go on, touching chiefly the situation with regard to available credits, the question of the daily increasing prices of raw materials which were not looked for when many of the contracts were let, and a still equally important question of taxing all reconstruction profits as war-profits as recently proposed by Monsieur Painlevé

It was finally decided to admonisn members, and architects as well, to undertake no new work without first being assured as to the solution of the various problems above set forth.

These resolutions were presented to the Ministry of the Liberated Regions for such action as it is possible to take at this moment, urging at the same time that some means be found to continue the financing of the work; otherwise more than a quarter of a million people in the building trades would be out of work.

The paving program for Paris streets for 1924 comprises 200,000 square meters of wood block paving which will be carried out under a new form of contract with the paving company, a contract analogous to the maintenance contract in operation in London. This is the first time such an arrangement has been put into operation in Paris and it is regarded with some misgiving.

In Paris the new contract form will cover only the preparing of the roadway, the laying of the wood blocks and the upkeep for the prescribed term of years. The city wood block manufacturing plant at Javel will be called upon to supply the material—the blocks—if required, at a predetermined scale, or the contractor may procure them elsewhere, the responsibility of their lasting out their term in either case being the contractor's.

No contract will be let which does not provide for completion within ten months and the upkeep clause may be extended to cover as much as fifteen years.

The new contract will be applied immediately upon some of the chief and heaviest traffic thoroughfares in the heart of Paris. Payment will be made in two installments, the first of 55 per cent upon the completion of all new work and its acceptance by the municipality and 45 per cent two years later.

The program of asphalt and bitulithic paving comprises three sections for 1924. The first is of a total area of 123,984 sq.m., calling for an expenditure of 8,940,000 francs. The second covers 116,055 sq.m., at an expense of 3,000,000 francs. The third is for 54,200 sq.m., costing 2,500,000 francs.

The entire surface of streets and sidewalks in Paris covers 16,808,800 sq.m., a length of 1,013 kilometers, divided thus:

	Square Meters
Streets:	
Stone blocks	5,416,200
Wood blocks	2,461,000
Asphalt	910,100
Macadam or similar	672,000
Sidewalks:	
Bitulithic	4,623,700
Granite slabs	642,100
Stone blocks	295,000
Asphalt	18,400
Dirt surface	338,400
Sanded alleys and paths	1,442,400

Sewage Treatment for the University Towns of Urbana and Champaign

Excavation by Tractors and Fresnos, Steam Shovels and Teams—Concrete Distribution Over Industrial Tracks

By C. R. Velzy
Resident Engineer, Urbana, Ill.

Abstract of paper presented at recent Convention of Illinois Society of Engineers on a plant which most sanitary engineers in Middle West will visit because of proximity to the University of Illinois and the number of preliminary reports and studies made.

THE SEWAGE-WORKS of the Urbana-Champaign (Ill.) Sanitary District consist of a screen chamber in which the sewage passes through a coarse bar screen, Imhoff tanks, a pumping station, which houses laboratory and offices, sprinkling filters and a sludge drying bed. Provision is made for the future installation of secondary settling tanks of the Dorr type.

The Imhoff tanks have a liquid depth of about 30 ft., a retention period of three hours for the dry-weather flow, a sludge storage of 2¼ cu.ft. per capita, and a gas vent area of 30 per cent of the total tank surface. There are four separate tanks each so baffled as to provide two flowing-through compartments and three gas-vent areas. The sludge beds are designed on the basis of 0.67 sq.ft. per capita with provision for easy extension to give 1 sq.ft. per capita. The beds consist of sand over gravel, in which are the underdrains.

The pumping equipment consists of three vertical centrifugal pumps of 2, 3½ and 5 m.g.d. capacity, working against a total head of about 24 ft. The pumps are located in a dry well adjacent to a wet well in such a manner that they can be automatically controlled by float switches. The dry-weather flow averages 50 gal. daily per capita and the wet-weather flow about double that rate. The plant was designed for a population of 50,000 people expected in 1935. It provides for a maximum capacity of 6.75 m.g.d. with a minimum of 1.37 m.g.d. and an average of 2 m.g. daily.

The two sprinkling filter units, which are designed for a population of 45,000, have a stone depth of 10 ft., cover an area of 1.6 acres, and are equipped with sprinkler nozzles. Underdrainage is effected by a valley-and-ridge floor, the ridges spaced 12 in. c. to c. and the valleys bridged by 1½ x 4 x 14 in. clay brick set on edge.

Two secondary tanks, proposed for construction within a few years are each 32 ft. in diameter, equipped with Dorr clarifiers for continuous removal of sludge, which may be pumped either back to the sludge beds or onto fill in the yard.

It is estimated that the operating cost, including power, a superintendent and two assistants, will be about $16,800 per year.

Excavation—In the largest item of excavation at the site of the plant, that for the primary settling tanks, the dimensions were 100 x 140 ft. and 33 ft. deep. The spoil from this excavation was to be distributed around the site of the plant at from 300 to 600 ft. from the settling tanks. The first 15 ft. of the excavation was done by means of two tractors, each dragging a Fresno scraper of about ½-yd. capacity. Some plowing was necessary to loosen the clay so that it could be picked up by a scraper, and some hand trimming at the edges of the hole was required but for a distance not more than 2 ft. from the vertical bank. The remainder of the excavation was accomplished first by a skimmer scoop excavator, then by a steam shovel. Both were lowered into the hole by traveling down the ramp used by the dump wagons. This entire excavation was accomplished without sheeting. The soil was mostly yellow clay with pockets of sand and gravel for a depth of about 12 ft., and below that level was a hard, impervious blue clay, which yielded no ground water although the excavation was carried more than 10 ft. below the level of water in the Saline Ditch, 200 ft. distant. Surface water caused the only trouble. Caving occurred on one side where a strata of water bearing sandy clay was exposed. The final trimming of the bottom for the hoppers of the settling tanks was done by hand and it was found expedient to use dynamite in this work on account of the very hard clay.

Construction—Although the extreme limits of the concrete structures for the plant cover a distance of 700 ft., the concrete for all major structures is being mixed at one point in a three-bag mixer. The distribution is accomplished by the use of industrial track and cars of ½-yd. capacity. The aggregate is measured in a patented measuring device consisting of a hopper mounted above the mixer having two compartments, one for sand and one for gravel. At the bottom of each compartment is a gated outlet leading into a pair of sheet metal cones, the lower cone with its apex downward and the upper cone with its apex upward. The space between the upper and lower cones is adjustable and by this means the quantity of aggregate which will flow into each set of cones is regulated. This measuring device has proved quite satisfactory, giving a constant yield of concrete per batch.

An interesting problem arose in connection with the pouring of hopper bottoms for the settling tanks, the slope of the sides of which vary from 1 to 1½ to 1 to 2. The sides were too steep to be poured without forms and to pour them with forms and a dry concrete would make it impossible to obtain a concrete free from honeycomb. The problem therefore was to build a top form and to anchor it securely in position and then to hold it against an upward pressure of more or less fluid concrete. By the method developed a block of concrete was first poured at the bottom or apex of the hopper with a bent bar anchored in it to serve as a tie for the forms. The forms were built over a templet in the yard and lowered into position in sections. Having placed the form, a center post was erected which was wired securely to the anchor in the block of concrete poured at the apex of the hopper. Walers were then placed along the sides of the hopper forms and braces set from the walers to this center post. The braces were set at an angle of about 30 deg. with the horizontal so that any upward pressure resulting from a tendency of any part of the form to rise would be transferred to the center post, which was securely anchored to the bottom. In addition the form was fairly covered with bags of sand which were placed as the concrete was poured. This method enabled the hoppers to be poured with no appreciable movement of forms.

Pearse, Greeley & Hansen, of Chicago, are consulting engineers for the Sanitary District of Urbana-Champaign; the writer is resident engineer; G. R. Radebaugh is general manager for the district. English Brothers, the contractors, had completed about one-third of the work last season.

Erect Fences in Various Climates for Paint Tests

TO DETERMINE what is the best way to paint different woods, the U. S. Forest Products Laboratory is about to erect painted fences at various points throughout the United States. The first fences will be put up at Sayville, L. I., Palmerton, Pa., Washington, D. C., Gainesville, Fla., Milwaukee and Madison, Wis., Fargo, N. D., and Seattle, Wash. Others will be located later at points to be selected in Arizona, California and Colorado. The experiment is designed to show the influence of the species, the direction of the grain, the content of resin and oils and the presence of knots, defects and sapwood upon the painting characteristics of wood. This test will also be the first painting study to show thoroughly the influence of widely varying climatic conditions on the durability of paint.

Eighteen important species of softwood will be employed. Four panels of each species will be on every fence, two presenting the edge grain and two the flat grain. Since the experiment is designed to test not the paint but the effect of a variety of conditions upon paint, only two standard types of paint will be used, made by formulas agreed upon by the co-operators in the experiment.

Wood used in the project is furnished by the California Redwood Association, the California White and Sugar Pine Association, the West Coast Forest Products Bureau, the Northern Pine Manufacturers' Association, the Northern Hemlock and Hardwood Association, the Southern Pine Association, the Southern Cypress Manufacturers' Association, the Coos Bay Lumber Company and the Finch Pruyn Lumber Company.

Other co-operators in this test are: The U. S. Bureau of Standards, the Institute of Paint and Varnish Research, the National Lead Co., the New Jersey Zinc Co., the Pittsburgh Plate Glass Co., the University of Florida and the North Dakota Agricultural College. The work of erection and painting will be done by the co-operators. Representatives of the laboratory will inspect the fences once a year. The wood finishing research committee is acting in an advisory capacity in this research. It has members representing the National Association of Wood Using Industries, the Engineering Foundation, the National Research Council, the American Farm Bureau Federation, the American Institute of Architects, the Musical Industries Chamber of Commerce and the furniture industry.

Indiana Bridge 1923 Activities

During the past year the Indiana State Highway Department built 235 bridges including 388 spans which, if joined together, would be 19,591 ft. long. The cost of these structures, which were designed to carry 20-ton traffic, was $2,780,000. The bridges were on fifty state roads; 125 were federal aid, 109 state aid and one county aid. For 1924, 150 bridges is the schedule; bids were opened on 87 structures April 15. At least eight railroads crossings will be bridged.

Novel Structural Details in Temple Building

Combine Concrete and Steel Columns and Girders—Concrete and Metal-Lumber Joists and Sound-Deadening Walls

A DUAL type of construction including both structural steel and reinforced concrete has been used in the new Masonic Temple at Madison, Wis. Reinforced concrete was used wherever practicable on account of economy, but for long spans it was found to be both uneconomical and impracticable to use concrete girders on account of the necessity of keeping them shallow. It was also necessary to use steel for columns of great unsupported height and under the roof trusses. The following description is abstracted from a paper read at the annual meeting of the Engineering Society of Wisconsin by Ellis J. Potter, architect, Madison, Wis.

Where the fancy detailing came in was at the places where the two types of construction came together. There was no particular difficulty about framing the steel into

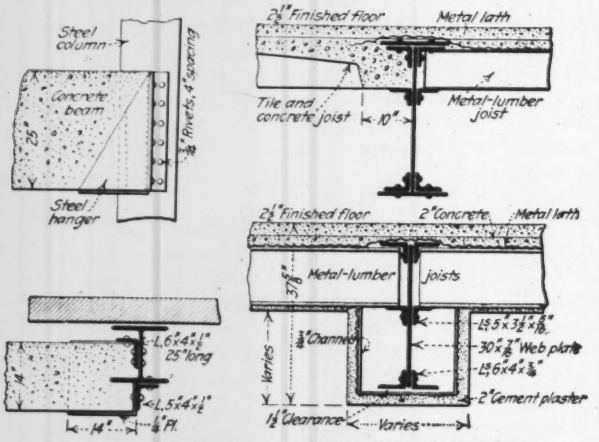


FIG. 1—STRUCTURAL DETAILS OF BUILDING
At left: steel column with stirrup to carry concrete beam. At right: girder sections, with joist supports and fireproofing.

the concrete, but when we came to frame a large concrete beam into a steel column we had to rivet a big scoop-shaped hanger onto the column in order to give the beam sufficient bearing. This is shown in Fig. 1.

In laying out the balcony of the big lodge room, a great deal of intricate scheming and special detailing was involved, because it is supported entirely by steel cantilever bracket trusses and plate girders, two of the latter being pitched nearly 3 ft. in their length of 45 ft. in order to keep them from projecting below the curved ceiling, which is furred right up under the girders at both ends. There are three 54-in. plate girders supporting the rear of the balcony. Two of these extend diagonally across the opposite corners of the room and are connected to columns. The third passes transversely across the room and is connected to the other two girders at about their quarter points.

Eight of the cantilever trusses pass through the webs of the girders and extend out an average of 11 ft. to the face of the balcony. They are anchored at the other end to steel columns in the wall, which extend up to the roof trusses. Six other cantilever trusses supporting the balcony at the sides, have a projection of 9 ft. and are riveted only to the steel columns. The columns have an unsupported height of 36 ft. across one axis, and besides carrying the brackets at about one-third their height they also support the roof trusses of 88-ft. span.

Deciding upon the most economical and practical type of floor for the first floor seating bowl and the balcony

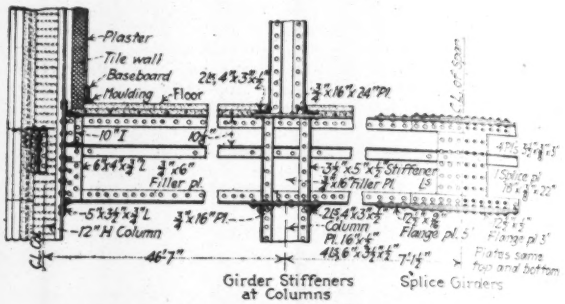


FIG. 2—FOUR-SUPPORT FLOOR GIRDER

was rather a delicate matter, because the seating rows were banked 14 in. above one another in the first floor, while the banks in the balcony were 28 in. In addition, 75 per cent of the work was on a curve. Reinforced concrete was carefully considered but it was felt that the curved forming would be very difficult, slow and expensive, so the work was finally laid out for metal lumber. The reduction in the dead-load through the use of the latter was one material advantage, also it is easy and quick to handle. Although one is bound to have difficulties in the erection of curved work of that kind, it is possible that concrete would be as economical in the long run. Metal lath will be placed on the steel joists and concrete with a troweled cement finish will form the seating banks. The treads are to be 2 in. thick and the risers 1½ in. Floor construction with concrete and metal-lumber joists is shown in Fig. 1.

It was a complicated matter to work out a suitable stair from the balcony to the street lobby, on account of having to provide landings at doors at proper locations and elevations and at the same time avoid girders, beams and trusses. In general, metal lumber floors were used where we had long-span steel girders, in order to keep the dead-load at a minimum. This occurs principally on the floors of the three lodge rooms, though it was also used for the floor of the attic of the front portion as the latter is carried on the lower chord of the roof trusses, this story being utilized for locker rooms. The floor construction of the remainder of the building consists of reinforced-concrete joists formed between steel domes.

We had several cases of plate girders with four supports, some of which have a wide center span and short end spans, while others are just the reverse. In all cases they were designed by the theorem of three moments and detailed so as to take advantage of all possible saving in weight of metal. An example of these four-support girders is shown in Fig. 2. One point which was overlooked in our anxiety to use the most economical materials was that of ease and consequent speed of erection. There are one or two places, for instance, in which skeleton construction instead of the wall bearing type would have facilitated the erection considerably, and though it would have cost more, it would very likely have been worth the difference in the long run.

Terrazzo floors are used for banquet rooms, passages and toilet rooms, being easily cleaned and not easily damaged. Linoleum is used for billiard and card room floors, because it is noiseless, resilient and not easily discolored. The roofing system consists of steel tees spanning between purlins and on them are placed sheets of gypsum board to serve as a form for a poured gypsum slab reinforced with wires. A tar and gravel roof is then placed on the gypsum. Though this roofing costs somewhat more than would a concrete slab on rib lath, it was selected on account of its insulation value in preventing heat loss, and because it forms a finished attic ceiling at reasonable cost.

A special problem in acoustics was presented by the use of three pipe organs, since it was necessary to deaden the walls between lodge rooms so that occupants of one room would not hear the organ playing in another room. It is hoped this will be fully accomplished by means of double dividing walls with a dead air space between them. This construction is shown in Fig. 3. In addition, all organ chambers will be lined with sound-deadening partitions. All motors, fans and elevator machinery will be placed on hair-felt deadeners.

This building is 132 x 182 ft., with a height equivalent to four stories and basement. The upper parts of the three lodge rooms and stage extend up through the level of the second story, but across the front of the building there are offices in this story. The banquet hall, 86 ft. wide, has only two rows of columns, with a 46-ft. central span and two 20-ft. side spans. This large room is in the basement and has a stage at one end. Blast fans will furnish air and ventilation to the principal rooms; exhaust fans will remove foul air from the kitchen and the billiard, card and toilet rooms, these last being served by a separate fan. The

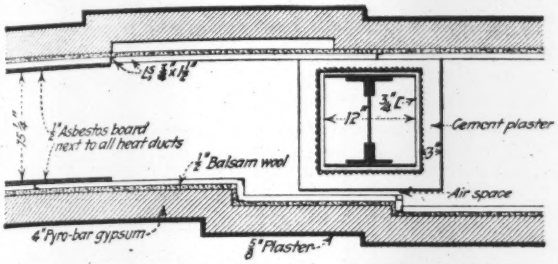


FIG. 3—DOUBLE WALL FOR DEADENING SOUND

building stands on a dry hard clay, for which a unit pressure of 6,000 lb. per square foot was adopted, which is the maximum allowed by the state building code. Footings are all of reinforced concrete.

The architects were J. R. and E. J. Law, and the structural design was in charge of Ellis J. Potter. The construction contracts amount to $449,500, giving a unit cost of 30½c. per cubic foot. This project was financed by selling 25-year notes to members and 6 per cent bonds to the public for amounts of $200,000 and $250,000 respectively.

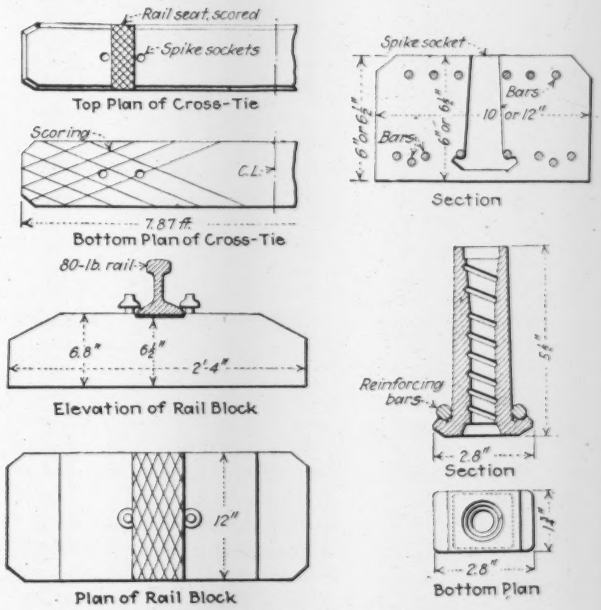
Concrete Ties for Light-Traffic Track in France

Reduction of Maintenance Forces and Cost Follows Replacement of Wood Ties by Concrete Ties and Pairs of Blocks

CONCRETE ties have been advocated as economical for yard and industry tracks, even though they appear unsatisfactory for main-line service. This view appears to be held by the Paris & Orleans Ry., France, which is now introducing a combination of reinforced-concrete ties and blocks of the Calot type to replace wood ties on secondary lines and branch. By July, 1924, this construction will have been applied on the entire length of the Hautefort & Terrasson line, 14 miles, according to an article in the *Revue Générale des Chemins de Fer* by Mr. Adam, chief engineer of maintenance-of-way. The new development is based on the results obtained with 600 ties of the same type laid in 1915 and 1917 on track carrying traffic with 18-ton axle loads and at speeds of 36 to 55 m.p.h. The line mentioned, having long grades of 2 per cent and curves of 984 ft. radius, carries four to six trains daily at speeds of 28 to 40 m.p.h. The 33-ft. 80-lb. flange rails were laid originally on ties of second-class oak and untreated pine. The concrete ties and blocks are shown in the accompanying drawing.

Five types of construction are employed, all designed by Mr. Calot, division engineer: (1) On curves of 1,000 to 1,150 ft. radius, each rail length has eleven lightly reinforced ties 12x6½ in. and 7.87 ft. long; (2) on curves of 1,300 ft. radius, twelve ties 6x10 in., with heavier reinforcement; (3) on curves of 1,640 ft., six ties of type 1 supplemented by five pairs of blocks, these blocks being independent and not connected by tie bars; (4) on curves of over 1,640 ft. radius, six ties of type 2 and five pairs of non-connected blocks; (5) for sidings and station tracks there are lighter blocks with alternate pairs connected by tie bars. All the blocks are about 12x6½ in. in section and 28 in. long.

In both ties and blocks the bottom surface is scored or grooved near the ends to give a grip in the ballast, and the rail seats are scored to give a frictional hold on the metal tieplates. The reinforcement consists of longitudinal bars in the top and bottom of the ties but at the bottom only of the blocks, with lateral wires hooked over the outer bars. Screw spikes of standard type form the rail fastenings, the spikes engaging threaded sockets of cast iron which are embedded in the concrete. Flanges on these sockets hook under the bottom reinforcing bars, as shown.



CONCRETE TIES FOR PARIS & ORLEANS RY.

At top: cross tie 7.87 ft. long. At bottom, left: blocks used in pairs. At bottom, right: socket for screw spike.

The first installation is estimated at $131,514 (taking the franc at 20c.); this is based on $5.80 and $5.10 for the two types of ties, $1.60 for each block and 85c. for placing each tie or pair of blocks. Salvage value of the wood ties at $1.20 reduces the total to $100,842. Creosoted wood ties cost about $2.40 to $3. It is noted that the first cost is high owing to the casting yard not being adapted for a large output. The cost of installation also is high, since the work had to be done under traffic and the wood ties renewed one by one. With new track the cost would be materially less.

It is expected that an assistant foreman with a flagman and three laborers will be able to handle all maintenance work on this 14-mile line, while formerly there were two section gangs, each consisting of a foreman, assistant foreman and three laborers. The work will consist mainly of tightening and renewing bolts and spikes, while general raising or surfacing of the ties will be required at intervals of five or six years. The life of the concrete ties and blocks is estimated at sixty years under the traffic conditions of this line.

Stability of Geodetic Benchmarks in United States

Research by U. S. Coast and Geodetic Survey in Locations Showing Elevation Changes Is of Value to Construction Engineers

By William Bowie
Chief, Division of Geodesy, U. S. Coast & Geodetic Survey, Washington

ELEVATIONS of precise-level benchmarks, thought by many to be forever unchanging, are really affected by those processes of nature which raise valleys to plateaus or mountains and bring elevated regions down to or below sea level. But, in general, the geological processes work slowly, in terms of human time, and few would be the changes that might annoy the engineer. There have been changes in elevation as great as 40 ft. in a vertical direction in restricted areas during a single earthquake, but such incidents are rare and need not be considered by the engineer, except in certain areas in which seismic activity is known to be great. One of those areas is the coastal region of California. The U. S. Coast and Geodetic Survey will rerun lines of precise leveling there to discover the rates of change in elevation of the earth's surface. Similar tests are planned along the coast of New Jersey which may be slowly rising or subsiding. In view of the civil engineer's deep interest in the constancy of elevation of basic benchmarks a brief discussion of the principal factors of the subject is offered in the present article.

Benchmarks and Leveling Errors—In a general way, it may be assumed that a substantial, well designed block of concrete set into the ground will hold its elevation. This should also apply to benchmarks set in outcropping rock or in large buildings having firm foundations. In such cases the only movements affecting the elevations would be very slow and the result of geological processes.

Precise leveling is capable of showing very small changes in elevation of benchmarks within a reasonable distance of each other, and also of showing moderate changes of a regional nature. Each line of levels is run in both directions, and the two accepted measures never differ more than 4 mm. times the square root of the number of kilometers in the distance between the benchmarks. The average correction to close loops of precise leveling is about 0.15 mm. per kilometer. On the average a loop of 1,000 km. will have a closing error of about 0.15 m. or 0.5 ft. When a new line of precise leveling is adjusted into the net the effect of the closing error is largely reduced.

Seismic Effects—The U. S. Coast and Geodetic Survey has for two years engaged in research to test the stability of the earth's surface in California. The field work thus far has been confined to the remeasurement of horizontal angles in the triangulation nearly all of which was done more than thirty years ago in that state. Some very pronounced horizontal movements have taken place, as is indicated by differences between the latitudes and longitudes derived from the early observations and those now being made.

It is planned to extend, in 1924 and 1925, lines of precise leveling over the areas known to be and suspected of being seismologically active. Already there is a line of precise leveling extending along the coast from San Francisco to San Diego, and another line from the latter place running eastward to Needles, Calif. Portions of these lines will be rerun to learn whether there have been vertical movements of the ground along the routes.

The results of the studies under way will have direct bearings on many matters of importance to engineers. Where decided changes in geographic position and elevation are occurring, buildings should be constructed along designs which will best resist earthquake shock, and power plants should be placed in locations least liable to earth movements. Aqueducts would be especially affected by such movements as were found to have occurred during the quake of 1906 near San Francisco.

For study of another phase of stability, a line of precise leveling is to be run in New Jersey from Highlands along the beach to Cape May and thence along the Delaware Bay and River to Philadelphia. This line which is to control surveys, maps, and other engineering operations, will furnish the basis for studies of vertical movements of the coast. At intervals spur lines will be run back of the coast to stable ground. By rerunning these lines in the future movements can be detected and the rate of movement determined.

Mining and Drainage Effects—Precise-leveling benchmarks were established and their elevations determined by the Survey in and near Butte, Mont., in 1906. When the leveling was repeated in 1910, it was found that the benchmarks had changed their relative elevations by amounts as great as 0.9 ft. The marks were substantial ones, and were recovered without doubt. It is believed that the movements were due to the settling of the surface caused by mining operations in the vicinity. It is probable that the earth's surface over any district where extensive mining is done will suffer some distortion which will be reflected in slight changes in the elevations of precise leveling benchmarks.

While no tests by precise leveling have been made in this country, it is well known that drainage operations tend to decrease the elevations of benchmarks in the affected regions. This is caused by the lowering of the water level and the subsequent compacting of the soil.

The leveling done by the Coast and Geodetic Survey between Perth Amboy, N. J., and Fort Hamilton, N. Y., in 1886-87 was rerun by F. W. Koop of the Board of Estimate and Apportionment of New York City in 1909-12. Mr. Koop found no changes in elevation greater than those incident to precise leveling. The coast must have been stable during the interval of 23 years or more between the two runnings. Mr. Koop extended his leveling over New York City, connecting with many old precise benchmarks. He found no material changes in elevation of benchmarks set into outcropping rock or in substantial masonry structures which had firm foundations. He did find decided changes in elevation for those old benchmarks which were located on or near docks, and in buildings located on made or alluvial ground in the city.

Frost Action—Investigations are being made by the Survey as to the best size and shape of concrete benchmarks to use in high latitudes in order to resist changes of elevation by frost action. This is a matter of importance, for it is most desirable that the fundamental elevations furnished by precise leveling should be preserved.

How a River Control District Is Building Its Reservoir

Organization of First River Regulating District Under New York Conservation Law—Details of the Stillwater Reservoir

By E. S. Cullings
Chief Engineer and Secretary, Black River Regulating District, Watertown, N. Y.

As THE Black River Regulating District was the first of such districts to be organized under the New York State Storage Reservoir Act (Article 7-A of the Conservation Law) the fact that the enlargement of the Stillwater Reservoir is now under way is of unusual interest because this reservoir is the first piece of construction to be undertaken under this important act. The reservoir is one of a series of reservoirs to be constructed on the Black River and its tributaries. Although the act was passed in 1915 and the Black River Regulating District was organized in 1919 its plans for the construction of reservoirs have been delayed until the present because all the pioneer work of operating under the new law and all the litigation over its various provisions have fallen on this district. This pioneer work is now completed and a second district, including the upper Hudson River, has been organized and petitions for the creation of other districts have been filed with the State Water Control Commission.

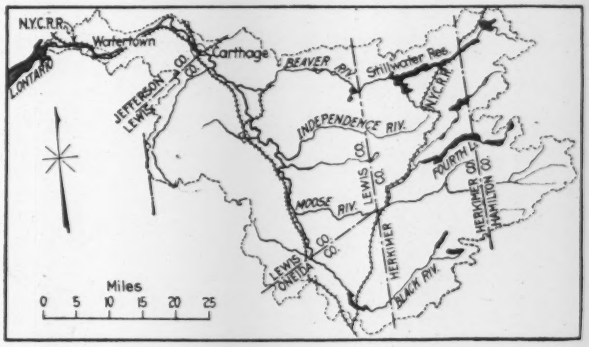
Briefly stated, these districts are public corporations, having perpetual existence and authority to construct and operate storage reservoirs, acquire real estate, issue securities, make assessments and exercise the power of eminent domain in the acquisition of land. The affairs of the district are managed by a board of three men appointed by the governor. At least two of these men must be residents or owners of property within the district. All acts of the district board are under the supervision of the Water Control Commission of the state, which commission is made up of the state engineer and surveyor, the attorney-general and the conservation commissioner. The law permits the construction of reservoirs on state lands, with the restriction that not more than 3 per cent of the state land in a forest preserve shall be used for reservoir purposes.

New York Conservancy Plan—The first work of the board, after assuming office, is to prepare a general plan for the regulation of the flow of the rivers of the district, showing the available and feasible reservoir sites, the area, capacity and cost of each, and other pertinent information. This plan, when approved by the Water Control Commission, becomes the "official plan" to which all reservoirs must conform. Once it is approved, the board may prepare preliminary plans for the construction of any or all of the reservoirs giving details of the structures to be built, the land to be flooded, the ownership of the land, and the estimated cost of the work. These plans are also submitted to the Water Control Commission for approval, and after approval must be presented at a public hearing to the people interested. The determination of the board is subject to review by the courts by certiorari proceedings.

The cost of any such reservoir is apportioned upon the beneficiaries in proportion to the benefit which the board may determine they receive from its construction. Their findings in this matter are subject to approval by the Water Control Commission and must be presented at a public hearing as in the case of the reservoir plans. The assessments are collected in the same manner as general taxes.

The cost of a reservoir may be paid in a single assessment or in less than 50 annual assessments. If paid for in annual installments serial bonds, secured by the assessments and running not more than 50 years, may be issued. These bonds are exempt from taxation and are legal investments for savings banks and trust funds. In the case of the Stillwater Reservoir, the cost of $1,000,000 will be paid in 50 annual installments and bonds will be issued to finance the work.

This law is somewhat similar to the conservancy law of Ohio and some of the drainage laws of the Mississippi Valley. Local management by men familiar with the needs of the district is provided and the entire cost is paid by those who receive the direct benefit. The acts of the board are subject to approval and supervision by state officers and to review by the courts, yet its powers are such that it can eliminate the chief obstacles in the way of developing the water powers of the interior streams of the state. The flashy character of the streams in New York State has made the economic development of many power sites impossible without artificial regulation and has reduced the continuous output of all the plants, but the construction of storage reservoirs has been held up for many years through the fact that the former legal restrictions against flooding state land prevented the construction of all the suitable storage reservoirs in the Adirondack region.



BLACK RIVER REGULATING DISTRICT, NEW YORK STATE

The Stillwater Reservoir—This reservoir is situated on the west side of the Adirondack Mountains at the headwaters of Beaver River, one of the tributaries of Black River, in Herkimer County, N. Y. The tributary drainage area is 178 square miles, most of which is mountainous and densely wooded. The average annual rainfall is 48 in., and the runoff, measured at the dam during the past fifteen years, is 26½ in. or 1.95 sec.-ft. per square mile. Below the reservoir Beaver River has a fall of about 914 ft., while the Black River falls 480 ft. between the mouth of Beaver River and Lake Ontario, making a total of 1,394 ft., a large proportion of which is now developed and utilized by paper mills and power plants. The total developed head on Beaver River is 460 ft. and on Black River 450 ft. The present Stillwater Reservoir was constructed by the state nearly forty years ago in part settlement of damage claims

arising from the diversion of water from Black River for the operation of the canal system of the state. It has an area of about 2,757 acres, an effective depth of about 10 ft. and a capacity of 900,000,000 cu.ft. The present dam consists of an earth embankment 500 ft. long and 35 ft. high, a concrete spillway section 200 ft. long and 20 ft. high, separated from the embankment by a small knoll of granitic rock. The spillway is founded on rock and the embankment partly on rock and partly on glacial hardpan. The outlet works consist of four 48-in. circular sluice gates which discharge into a tunnel around the south end of the spillway.

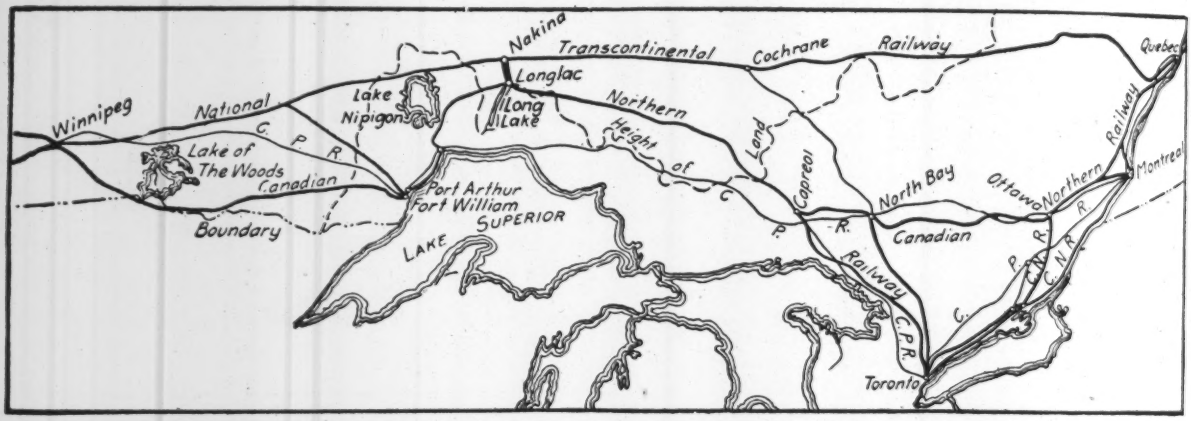
Plans for the enlargement of the reservoir call for raising the dam 19 ft. to increase the permanent area to 6,715 acres and the capacity to 4,500,000,000 cu.ft. In increasing the height of the embankment the upstream slope will be reduced from a one on two slope to a one on two and one-half slope. The height of the concrete spillway will be increased 17 ft. and it will be provided with 2-ft. flash-boards. The increase in water level will necessitate the construction of a second earth embankment 300 ft. long and 20 ft. high and of a second or auxiliary spillway 200 ft. long across two valleys south of the present structure. The auxiliary spillway will consist essentially of a concrete cutoff wall built in a trench across the valleys at a point where ground lines correspond approximately to the flow line of the reservoir. It will also be provided with 2-ft. flash-boards and its length added to that at the main spillway will make possible the discharge of the assumed maximum flood flow of 6,600 sec.-ft. and keep the flood height within the limits of the flow line of the reservoir. The new outlet works will consist of a series of five sluice gates, ranging in size from 24x24 in. to 48x48 in., set in gate wells at the south end of the spillway. Owing to the necessity of keeping the present reservoir in operation during the period of reconstruction the construction of entirely new outlets was decided upon. When the new ones are built the old ones will be plugged with concrete and the outlet tunnel will be abandoned.

Auxiliary work will include raising about 1½ miles of the New York Central track where it crosses the reservoir, the building of a new bridge across the south branch of Beaver River and the clearing of the 4,000 acres of land flooded at the ncreased height. The law requires the clearing of all land below the flood flow line. The timber on the 3,000 acres of state land to be cleared was sold in August, 1923, and it is expected that the lumbering operations will be completed by the fall of this year and that the entire work of enlarging the reservoir will be completed before the spring flood in 1925.

A contract for the raising and rebuilding of the dam and spillway was awarded to Scott Brothers Construction Co. in December, 1923.

Canadian National Railways Complete Longlac-Nakina Cutoff

A CUTOFF that is unique in railway development has recently been completed by the Canadian National Railways. Its construction was made possible through the consolidation of the National Transcontinental Ry. and the Canadian Northern Ry. into the National Railways, thus giving the National Railways two through lines from eastern Canada to Winnipeg. The accompanying map shows the peculiar relation of these two transcontinental railways in the territory north of Lake Superior.



CANADIAN NATIONAL RY. THROUGH LINES FROM EASTERN CANADA TO WINNIPEG

The National Transcontinental, running in an almost straight line from Quebec to Winnipeg through the comparatively flat land of the clay belt north of the height of land passes north of Lake Nipigon while the Canadian Northern, also taking advantage of the clay country north of the height of land passed to the north of Long Lake and then turned south down the Nipigon River to Lake Superior in order to connect with its line into Fort William. At the northern end of Long Lake the two railways were only about 30 miles apart.

When the two railways were consolidated it was realized that by constructing this 30-mile connecting link at Long Lake it would be possible to reduce the distance between Toronto or Montreal, and Winnipeg by 102 miles and the distance between Quebec and Port Arthur by 99 miles. The greater advantage of the cutoff is, however, in the saving in all rail freight movement between Winnipeg and Toronto or Montreal both in distance and in vertical rise and fall formerly required on the C.N.R. route in going down to lake level at Fort William.

Work was started in January, 1923, and the new train schedule over the cutoff went into effect in January, 1924. The total cost was about $2,000,000 and the annual saving is estimated at about $400,000.

Concrete Piles Resist Action of Sea Water for Five Years

Precast Sheetpiling Apparently in First-Class Condition—Special Care Used to Obtain Dense Concrete

By Charles M. Spofford
Consulting Engineer, Boston, Mass.

RESISTANCE of good dense concrete to the action of sea water is well shown by the precast concrete sheetpiles used in bulkheads at the Boston Army Supply Base and driven in the summer of 1918.

In order to utilize the extreme easterly portion of the site of this project, it was necessary to build bulkheads to restrain the earth fill. The necessity for speed made it impossible to build gravity retaining walls; hence it was decided to employ reinforced-concrete sheetpile bulkheads on either side of this portion of the site. These bulkheads were parallel, located about 250 ft. apart and secured against overturning by long steel tie-rods embedded in concrete and extending from wall to wall. The sheetpiles acted as vertical beams supported between the cap beams to which the foregoing tierods were attached and the earth of the harbor bottom into which the piles were driven, the force applied to the beam being the earth pressure due to the fill behind the bulkhead. The piles also helped to support the outer column loads of the pier shed. In order to give sufficient bending resistance the piles were heavily reinforced.

The piles were cast in a horizontal position and were composed of 1:1½:3 concrete, gravel being used for the coarse aggregate and special care being taken to get a dense smooth-working concrete. The concrete was well rammed until the upper surface was flushed, and this surface was given a smooth troweled finish before the concrete set. The piles were driven with this specially finished surface on the outer side of the bulkhead where it was directly exposed to wave action. The piles were 18 x 21 in. in cross-section, the 18-in. dimension being along the line of the bulkhead, and from 30 to 40 ft. in length. The corners were well rounded and the piles had tongues and grooves in order to make the bulkhead tight. The piles were cast in the summer under careful engineering inspection and no pile was driven until it was at least thirty days old. The driving proved to be very slow even under a ten-ton steam hammer aided by powerful jets, and the fact that the piles stood up well under the hard driving to which they were subjected proved clearly the high character of the concrete.

The bulkheads are not exposed to the open sea but they are subjected to more or less wave action; they are, however, somewhat protected from floating objects by the timber pile constructions of the wharves outside the bulkhead.

In January of the present year a careful examination of these sheetpiles was made by a party of Boston engineers which included Colonel Charles R. Gow, constructing quartermaster of the Base, members of the firm of Fay, Spofford & Thorndike, the designing and supervising engineers, and representatives of the Raymond Concrete Pile Co., the firm which constructed and drove the piles. The condition of the piles after five and one-half years of use was found to be remarkably satisfactory. Every one of the piles was observed from a motor boat which cruised slowly along the outer edge of the wharf, about 30 ft. from the bulkhead, and no pile was discovered that showed any visible defects. In spite of the almost conclusive evidence of the excellent condition of these piles thus obtained, a closer examination was made of a few chosen at random. The thin layer of oil and mud which adhered to the piles between high and low water lines was scraped off, exposing in each case a surface resembling an iron plate. Such surfaces were struck with a heavy steel-pointed pole and attempts were made to scratch them with a sharp steel tool but they resisted such efforts in a way to demonstrate clearly that the concrete was as hard and firm as when the piles were driven. Even in certain cases where, due to trouble in driving, the sharp corner of the tongue was exposed, such corners showed no defects due to sea action.

The fact that these piles show no deterioration in this time is an excellent illustration of the resistance of first-class concrete with a smooth hard surface to the influence of sea water.

Land Drainage and Game Preservation

IN VIEW of the present activity of sport and hunting interests in opposing land drainage for agricultural development, there is interest in the following quotation from a recent official report by E. R. Jones, state drainage engineer of Wisconsin:

Fish and Game Preserves—During the past year rod-and-gun clubs have become aggressive in obstructing drainage because of their belief that drainage encroaches upon hunting and fishing. This opens three questions: (1) Shall the state of Wisconsin which, since 1850, has sold these swamp lands to citizens under promise that the proceeds of the sales shall be devoted to the drainage of those lands, but which has violated its trust by spending these moneys for something else, still further violate its trust by refusing to let these landowners drain these lands if they are willing to pay for the drainage; (2) which marshes will contribute more to national and state prosperity by remaining in their present wet condition than by being drained for agricultural purposes; (3) how are the owners of the marshes that are to be set aside for fish and game to be paid for their land?

The coming year may have to answer some or all of these questions. The logical answer is to work out a broad constructive program that will let land drainage, land clearing, reforestation and game preservation proceed, each on lands selected for its particular purpose. These purposes should not conflict. Some of the cheap wet lands, not particularly adapted to agriculture, may well be set aside exclusively as public game preserves.

Drainage is not necessarily inimical to game preservation. There is better fishing today in the running waters of the ditches in the Portage County Drainage District than there was in the stagnant water on the marshes before drainage. There are more prairie chickens thriving on shelled buckwheat in the Little Yellow District than could live on the wild vegetation before drainage. Trapping in the Cutler District is easier and better along the ditches now than it was on the marshes before drainage. Furthermore, the drainage ditches control fire, as a deep drainage ditch is a barrier that a fire cannot cross. The fires of 1893 which swept over the big marshes of central Wisconsin and destroyed most of the game have not been repeated since drainage was introduced.

The proposed dike along the Mississippi river in the First Levee and Drainage District of Crawford County which is bitterly opposed by the Izaak Walton League, will prevent floods that now cause fish to be marooned in shallow sloughs. The drainage obstructionists charge that the Horicon Marsh and the Crawford County bottoms are worthless as agricultural lands, but the alleged failure of the Horicon is due to the hunters, who would not let the farmers drain it as deeply as it should have been drained. The Crawford County bottoms contain a rich silt soil with but few sand deposits. There are plenty of cheaper marsh lands that may be set aside exclusively for game.

Alleviation and Remedy of Street Congestion

Misuse of Street Space—Improper Routing—Unscientific Street Plans—Increasing Street Space—Decentralizing Business—Centralized Traffic Control

By Harland Bartholomew
City Plan Engineer, St. Louis, Mo.

The problem of street congestion has become one of primary importance in almost every city. From the small country village where the town policeman directs traffic at the four corners, and from the large city with its block signals and proposed vehicular subways and elevated streets, come innumerable suggestions for the relief of the streets. Yet no satisfactory solution of the problem has been found.

Engineers will, therefore, be interested in the following broader analysis in a paper read before the annual meeting of the American Electric Railway Association at St. Louis, Mo., March 4, 1924, by Mr. Bartholomew.—Editor.

STREET congestion is an economic problem and must be so approached. It is impedence to traffic in the Chicago due to parking alone causes an economic loss of $60,000,000 a year. This is a super-tax on all citizens equal to one-third of the regular taxes levied by the city itself. It is obvious that such excessive and unnecessary charges if long continued will have serious results. Expenditures upon devices which offer only temporary relief merely postpone the day of reckoning. All action and all expenditures should aim at a permanent solution of the traffic problem. The logical mode of attack should be by the following steps:

1. Secure the maximum use of existing street space.
2. Reduce the volume of non-essential traffic in congested centers and expedite the movement of that which remains.
3. Increase the amount of street space when economically justifiable.

Neither of the first two suggestions above need involve anything but minor outlays of public funds. Both would seem to be natural means of approach to the problem of street congestion.

Use of Street Space—Improvident use of street space is a common fault of cities. The streets of the business district of St. Louis with few exceptions are 60 ft. wide and have a normal capacity of four lines of vehicles. On these streets 2,500 cars may be parked. On an average day from 13 to 15 per cent of the number of standing vehicles are commercial. Pleasure cars alone occupy approximately 20 per cent of all street space. At a normal hour durinig the day moving streetcars occupy but 1.5 per cent of the street space. During the rush hour, when every available square foot of roadway ought to be devoted to movement, parked cars still absorb 20 per cent of the roadway. The vehicular flow thus restricted and confined to narrower channels slows so that from 50 to 100 more streetcars accumulate in the district than should be there according to schedule. Two thousand vacant, standing automobiles cause the streetcars, carrying 75,000 or more persons home from work, to lose from 5 to 15 minutes of scheduled time. It is estimated conservatively that parking during rush hours reduces the efficiency of streets in the business district to 36 per cent.

Something over 52,000 vehicles entered the business district of St. Louis daily (11-hour period) in 1922. During the maximum hour by actual count 9,843 vehicles entered the business district, whereas there was only a total area available for parking 2,500 cars, or somewhat less than 25 per cent of the maximum hour arrivals. There is a parking limit of one hour. Even if this regulation were strictly enforced during the 11-hour period but half the cars entering could be parked for the hour. Manifestly it is impossible to provide parking space in the streets of the business district of any moderate-size city for the accommodation of all vehicles. Street space, therefore, should be put to the service of the greatest number.

Careful study of roadway widths in congested centers will frequently show that a slight change either in parking rules or in the roadway itself will make an appreciable difference in the flow of traffic. The pavements in the business district of Chattanooga, Tenn., were not designed for angular parking but practically every street was so used. Vehicular movement was seriously impeded and traffic conditions were intolerable. Market St., which carries a double-track car line and which should be a commodious six-line thoroughfare, was reduced to a two-line street. The institution of parallel parking has cleared the streetcar right-of-way and opened up two new channels for other vehicles.

The improper routing of transit lines is a common source of trouble in congested centers. Left-hand turns are frequently made directly across the flow of traffic on the busiest street. A slight change in routing which would not inconvenience the riding public would entirely eliminate many of these left-hand turns at strategic points and bring the remainder at corners not so important.

One great contributing factor in the problem of street congestion is the unscientific street plan possessed by most cities. Unsystematic routing of traffic is frequently due to the lack of suitable streets. The automobile seeks direct routes and few of these are available in the average city.

How to Relieve Traffic Congestion

1. It is impossible to provide sufficient street space for all automobiles.

2. The provision of parking space in city streets is not a public obligation.

3. The parked vehicle must give way to the moving vehicle.

4. Curbs should be so adjusted as to permit maximum use of roadway space based upon lines of traffic.

5. Every city should have a comprehensive city plan.

6. The volume of traffic should be reduced by excluding passenger automobiles from certain streets or from all streets in areas where congestion is most acute.

7. Building heights should be rigidly restricted.

8. Street widening, subway construction, arcading or elevated sidewalks do not in themselves constitute a solution of street congestion and should be undertaken only where economically justified.

9. The city plan should include a major street plan providing for ample traffic circulation between all parts of the community, with streets of sufficient number and width to constitute balancing of traffic movement and prevention of over-concentration at any one or more points.

10. Separation of commercial traffic from that of the pleasure automobile type is desirable and should be secured where possible.

11. No streets should provide for more than eight lines of traffic. (This does not imply that streets eventually intended to accommodate rapid transit lines should not be given sufficient widths and where possible these should be 100 ft. for subways and not less than 200 ft. for elevated lines.)

12. Safety isles should be provided at crossings for all six-line or wider line roadways.

13. Bypass streets should be provided on all sides of the business district.

14. All approach streets to business districts should be carried through the district.

TABLE I—ANALYSIS OF TRAFFIC IN FOUR LARGE CITIES

City	Population, 1920	Autos Registered, 1923	Number Vehicles Entering Business District Daily: Passenger	Auto Trucks	Horse-drawn	Total	Passenger Autos in Business Dist. per 1000 Pop.	Per Cent Commercial Vehicles
Chicago	2,701,705	206,393	42,130	17,180	14,500	73,810	15.6	43.0
St. Louis	772,897	92,714	33,252	10,780	2,805	46,838	43.0	29.0
Pittsburgh	588,193	.....	32,416	20,554	7,545	60,515	55.0	46.3
Minneapolis	380,582	60,000	61,181	11,012	1,223	77,727	162.0	20.0

Even more difficult than the unscientific apportionment of roadway spaces in relation to lines of travel is the unscientific width and arrangement of streets that might be expected to afford a satisfactory scheme of circulation in any given community. A study of the traffic problem even in small communities usually discloses certain street openings, cutoffs or widenings, often inexpensive, whereby new routes of travel might be opened that would afford considerable relief throughout the whole city.

An examination of Table I indicates that the great bulk of vehicle movements in any business district consists of individual passenger automobiles that have little relation to the business of the district. Less than 50 per cent of the traffic which is composed of commercial vehicles undoubtedly does have relation to the transaction of business. The passenger automobile causes most of our street congestion because of its great preponderance of numbers. It is therefore suggested that passenger automobile movement in congested districts be entirely restricted, or at least confined to certain streets so that so much street space as may be necessary can be made available for the commercial vehicles that have most direct relation to business, and for streetcars that carry by far the greater bulk of people.

Increasing Street Space—It is an obvious impossibility to widen streets in the existing business district. This condition obtains in most cities of approximately one-half million population or greater. Removal of streetcars from the surface of the streets by building subways has been proposed, as well as the arcading of sidewalks, elevation of sidewalks and similar palliatives that do not of themselves constitute a solution of the problem of street congestion. They are mere make-shifts to relieve a temporary condition and by their very nature will invite more traffic and consequently a pyramiding of problems, physical and financial. Obviously they cost money and considerably more money than the advocates of these proposals realize. How few cities, for instance, can afford subways in business districts or rapid transit lines outside the business districts. Table II has been prepared to show the approximate present costs of subways and the necessary riding which must take place in order to produce sufficient revenue to justify the expenditure. The figures are prepared on a basis of present prices and under conditions that obtain in St. Louis as regards fares and construction costs.

The writer knows of no existing condemnation precedents by which anything approximating accurate estimates of cost for sidewalk arcading can be made. It is obviously an expensive process. The same is true of sidewalk elevation. Why should we undertake costs for these necessarily expensive projects when they do not constitute a real solution of the problem of street congestion? Where an extremely aggravated condition of congestion occurs one of these several measures might properly be undertaken, but this would not necessarily justify wholesale adoption of such measures for the relief of all street congestion. For example, it has been estimated that the value of time delays to individual vehicle movement justifies a capital expenditure of $6,000,000 for the double-decking of Michigan Boulevard in Chicago, a notable improvement recently completed. The Michigan Avenue project cost approximately $15,000,000 of which $6,000,000 was attributable to double-decking, indicating that in this particular instance the large extra expenditure was justified. Figures compiled by the same authority show that in the proposed South Water St. improvement, which is estimated to cost $22,000,000 and which involves double-decking, $11,000,000 is directly chargeable to double-decking, whereas, on the basis of time delays to individual vehicle movements, the maximum justifiable capital expenditure was estimated at $3,000,000. South Water St. is Chicago's principal produce center and naturally a busy and congested traffic center. If double-decking falls so far short of economic justification in a district of that kind, how much more unjustifiable it would be in other parts of Chicago's loop and, for the same reason, unjustifiable in the business districts of other cities.

TABLE II—RELATION OF COST OF RELIEF TO SERVICE

Cost per mile of roadway and track structures necessary to the operation of different kinds of urban transportation facilities.†

	Cost per Mile of Roadway	Passengers per Year per Mile To Pay Fixed Charges
Trackless trolley	$5,200	9,000
Single-track light traffic line	32,000	46,000
Double-track light traffic line	61,000	88,500
Single-track heavy traffic line	92,000	133,300
Double-track heavy traffic line	194,000	282,000
Two-track elevated all steel construction	540,000	486,000
Two-track elevated steel and concrete	1,060,000	1,305,000
Double-track subway	4,800,000	5,570,000

† Estimates prepared by William E. Bennett.

Decentralization—It is believed that the suggestions above offered constitute a solution of the street congestion problem for a considerable number of years and do not involve economic waste. Beyond that point there is but one conclusion that can be reached, either our congested, overcentralized cities will eventually become victims of economic strangulation, or business must be decentralized. This may come about in several ways. There may be an ever-increasing number of business centers developed in various parts of the city's area constituting a city of metropolitan organization composed of innumerable small communities each with its own center, or the huge central business district must be flattened out by rigid height restriction and spread over an increasingly greater area.

One more suggestion might be offered. Unsatisfactory handling of traffic problems today is due to the lack of a centralized authority having complete responsibility in the matter of street congestion. The whole problem has virtually been thrown upon the police department as the agency best suited to cope with the situation. It would seem that for the establishment and enforcement of permanent policies there should be created a separate department or commission or agency which should at least be charged with the duty of studying the problem and which should probably also be charged with full responsibility in handling traffic.

Refuse Used to Restrain Drifting Sand

The Forestry Section of the Agricultural Department of the Union of South Africa is conducting an interesting experiment at Bellville, about 12 miles from Cape Town, in converting sand dunes into forest area. There is a wide belt of sand dunes in this section, which is not only worthless in itself but on account of the shifting character of the sand is a menace to the surrounding country. The Forest Service is transporting the rubbish from Cape Town in closed standard-gage cars to a railhead on the sand dunes, where it is transferred to light, narrow-gage cars and is spread out over the surface of the dune. This refuse contains not only the usual city rubbish but also the remains of the garbage after material which is available for the manufacture of fertilizer has been removed. After the refuse has been spread out a grass seed of a special French variety called marram is thrown broadcast over the area and this is followed by the distribution of seeds of a variety of wattle tree, the *Acacia Saligna*, a native of Australia, which has been found suitable for such purposes. A peculiarity of the marram grass is that cattle will not eat it; it has been used for this reason because the dunes join a pasture area. Another peculiarity of the grass is that it dies out after three years, but by this time the trees have formed sufficient root so that they are able to prevent further drifting of the sand.

Study of Flocculation Phenomenon with Microscope

Excess Coagulation, Toughness of Floc and Results of Rapid Mixing Explained Largely on Physical Basis

By John R. Baylis
Principal Sanitary Chemist, City Water Department, Baltimore, Md.

COAGULATED matter passes the filter beds at most filter plants using aluminum sulphate as a coagulant. Various reasons have been assigned for such troubles, but probably it has not occurred to many that over-coagulation may be responsible. Microscopical examination of floc that filters excellently, and that which passes the beds readily, has revealed a great difference in its structure. This observation has led to a thorough investigation, at the Montebello filter plant at Baltimore, of floc formation, more from the physical than from the chemical standpoint. The work is still under way, and this short article is to be regarded as an announcement to enlist the interest of other filter operators more than as a complete exposition. Several phases of the work require time, seasonal changes and variable characters of water to prove thoroughly what now seems obvious; however, the facts already revealed, and there is no possibility of their being upset, are remarkable.

FIG. 1—ALUMINUM HYDROXIDE FROM MIXING BASIN EFFLUENT—PROPER AND OVER-COAGULATED FLOCS

Basin water turbidity 90 p.p.m., alkalinity 39, pH 7.1, before application of alum. The smaller floc produced by the addition of 4.5 grains per gallon of alum and 1 grain of lime settled slowly. Alum was applied 5 minutes in advance of lime. Mixing basin effluent alkalinity 13 and pH 6.0. The suspended matter is largely in the center of floc, whereas the more compact large floc produced by 1.1 grains of alum is evenly distributed. The effluent when the large floc was formed was 30 p.p.m. and pH 6.6.

The camera lucida drawing of large well-formed floc in Fig. 1 shows a uniform distribution of the suspended particles through the floc. This is significant and there must be a reason. The particle of floc shown is small compared with the average, a small one being selected in order that the entire particle could be observed under the microscope. The uniform size of suspended particles within the floc is caused from the fact that the water passed through a large storage reservoir before reaching the filter plant. Contrasted with the poorly-formed floc in Fig. 1 the suggestion of over-coagulation is evident. Over-coagulation produces a variety of structures, depending on the amount of over-coagulation and the time consumed in getting the alum thoroughly mixed with the water. The particles of suspended matter may be uniformly distributed if there is rapid mix, but much farther apart, or the floc may be composed of clusters of fairly compact particles surrounded with aluminum hydroxide of considerable thickness.

The most plausible explanation for the variable structural formation is that there is rapid adsorption of the aluminum hydroxide by the particles in suspension. A tougher and more compact mass of hydroxide is probably built up around the particles, having its maximum toughness next to the surface and gradually diminishing as the distance increases from the surface. Frank Hannan, in an article on "Microforces" in the November *Journal* of the American Water Works Association, refers to a stagnated layer of water immediately adjoining solid surfaces, and to the fact that there might be greater chemical activity within this zone. Assuming the "brush-heap" formation for the structural formation of gelatinous substances, it is readily seen how the fibers may be built up into a compact network around the suspended particles. This may be caused by the Brownian movement of the particles, or the curvature and stagnant layer around them. That the presence of suspended matter causes a tougher and more compact floc to form seems proved beyond doubt, providing there is the proper ratio between the surface of the suspended matter and the aluminum hydroxide. Space does not permit a detailed statement of experiments conducted to prove this assumption, but the fact that properly coagulated turbid waters will build up a much greater loss of head in filtering through rapid

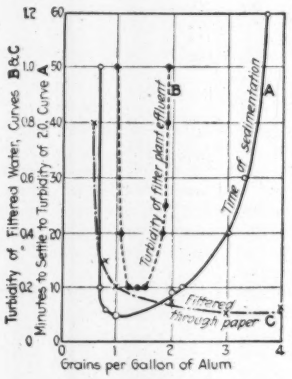


FIG. 2—EFFECT OF VARIABLE AMOUNTS OF ALUM ON TIME TO SETTLE AND TURBIDITY

Curve *A*: laboratory samples at room temperatures stirred 15 minutes at 100 r.p.m. and allowed to settle to a turbidity of 2 p.p.m. Curve *B*: turbidity of filter effluent under varying doses of alum. Curve *C*: results of filtering same coagulated water through No. 12 Whatman paper.

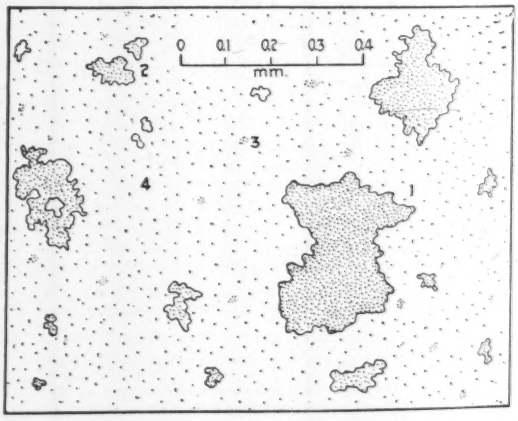


FIG. 3—POORLY-FORMED COAGULATION DUE TO SLOW INITIAL STIRRING

Raw water turbidity 25 p.p.m., alkalinity 39, pH 7.1 treated with 0.8 grains of alum; stirred slowly 5 minutes then for 15 minutes at 100 r.p.m. It settled to a turbidity of 15 in 40 minutes and filtered to a turbidity of 5 p.p.m. through No. 12 Whatman paper. Camera lucida drawing after 90 per cent of the supernatant liquid poured off. The solution contained well-formed flocs (1), floc with an excess (2) and deficiency (3) of aluminum hydroxide as well as individual (4) suspended particles.

sand filters without passing coagulated matter than will well-coagulated water with little suspended matter, offers most convincing proof of its increased toughness due to suspended matter. The slowness with which alum forms a coagulation in clear water shows that the suspended matter has great bearing on the time required for floc formation. One grain per gallon of alum in water having a turbidity of 50 p.p.m. will form a good coagulation as quickly as 10 grains will in clear water when all conditions such as alkalinity, rapidity of mix and time and speed of stirring are the same. If the theory of "brush-heap" formation is correct, the more concentrated are the substances forming gels the shorter will be the distance between the points where the fibers connect and the quicker will be the time required for formation. What the suspended particles do is to compact the gel immediately surrounding them and if the distance between particles is not excessive toughness will be added to the floc.

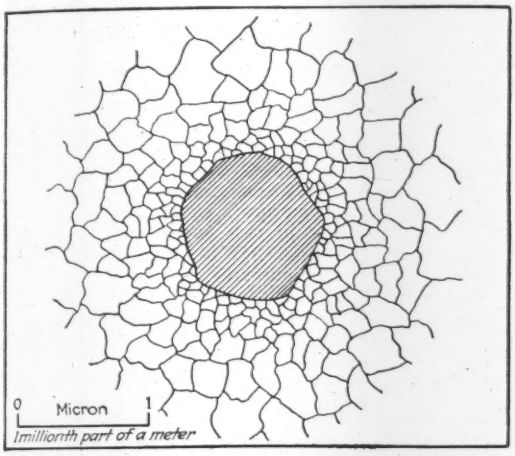


FIG. 4—"BRUSH HEAP" REPRESENTATION OF COAGULANT ADHERENCE TO SUSPENDED PARTICLE

Curve *B* in Fig. 2 is worth the careful consideration of all filter operators using alum as a coagulant. It is from actual plant results, and is probably what will happen at other plants under similar conditions. The dosage of alum was increased to 4.5 grains per gallon for an experiment and resulted in a floc turbidity of 15 p.p.m. passing the filters. Alkalinity and *pH* at this high dosage were well within the bounds of safety, and the fact that the filters would filter the water clear for about an hour after being washed shows that the toughness of floc was the main factor. A filtering medium having very small openings such as filter paper will remove the aluminum hydroxide regardless of its weak structure, but with the large openings in coarse sand beds there must be some toughness to the substance being filtered if the actual loss of head through the sand beds is allowed to build up over a few inches more than it would be with clear water going through. Variable conditions of the water and substances in suspension and solution will alter the filtering qualities of the floc produced, but with all the other conditions equal the suspended matter varies the toughness.

If there is rapid adsorption of the aluminum hydroxide around the suspended particles it suggests the value of a rapid mixing of the alum immediately after application. Mr. Hannan has suggested to the writer that there may be compounds other than aluminum hydroxide formed if the time of mixing is slow. Such a possibility is being investigated with the results indicating that it does happen to a slight extent. However, all experiments conducted to prove the assumptions given in this article have been made with a rapid initial mix.

The investigation at the time of this writing (March) has brought out the following interesting facts: (1) Great danger of over-coagulation exists; it produces an easily broken floc that will readily pass rapid sand filter beds. (2) The microscope may be used with considerable advantage in studying coagulation. (3) Suspended matter adds toughness to the floc. (4) There should be a rapid mixing of the alum with the water immediately after application.

Seven Railroads Apply for Permission to Build in Texas

By C. A. Matthaei
Washington, D. C.

SEVEN applications for "certificates of public convenience and necessity" have been filed with the Interstate Commerce Commission for permission to construct new lines of railroad in Texas. These lines will not only have intrastate significance by developing the country which they will traverse, but they will also be of interstate and international importance.

Of the proposed railroads, the one that will be most important from an international standpoint, besides developing a vast agricultural and oil territory, is the Nueces Valley, Rio Grande and Gulf R.R. This road proposes to extend a line from Beeville, the western terminus of the Southern Pacific R.R. (Victoria branch), to Laredo on the Mexican border; which city is known as "the gateway to Mexico." This line together with the Southern Pacific and certain railroads of Mexico will make a direct line from New Orleans via Houston and Laredo to Mexico City, thus furthering commerce with that country.

The Waco, Beaumont, Trinity and Sabine R.R. proposes to build its new line from a point in central east Texas to the ports of Beaumont and Port Arthur on the Gulf of Mexico; thus facilitating the movement of crops from that region, and traversing a very large cotton, rice, and lumber belt, besides a very fast growing and large industrial section.

In north Texas, the Texas, Panhandle and Gulf R.R. Co. plans to build a line from a point in New Mexico, and in connection with other lines will run east to Fort Worth, Texas. This road will cause the establishment of a number of towns in the plains country, and will be of a great agricultural value.

The two railroads that are seeking to furnish an additional outlet to the lower Rio Grande Valley, where numberless citrus fruits and numerous other products are raised, are the San Antonio and Southern R.R. Co. and the Rio Grande and Northern R.R. Co. These roads also contemplate going through certain oil fields in Webb County, Texas.

Another railroad company, the San Antonio and Mexican R.R. proposed to build a line from a point on the San Antonio, Uvalde and Gulf R.R., to certain oil fields in Webb County, Texas.

The Rockdale and Southern R.R. Co. applies to build a short line from the city of Rockdale, Texas, to the lignite fields of that section.

Advisory Board Submits Report on New England Power

Survey of Power Facilities, Requirements and Possible Sources of Supply—Water Power From Canada

FOLLOWING a decision on the part of some eighty representatives of the larger users and producers of power in New England to undertake an analysis of the power possibilities of that part of the country and of the probable cost of power to be produced by subsequent developments, the Associated Industries of Massachusetts in March, 1923, appointed a committee consisting of Charles T. Main, chairman; Henry I. Harriman, president of the New England Power Co.; Dugald C. Jackson, of the Massachusetts Institute of Technology, and of the firm of Jackson & Moreland; George L. Finch, power superintendent of the Hood Rubber Co., and B. Preston Clark, vice-president of the Plymouth Cordage Co., to undertake such a study. The committee was asked to report on the present power requirements of the New England industries and their probable growth during the next ten years, on the possibility of railroad electrification, and upon the geographical distribution of power requirements. In addition, it was to study all the available sources of power, particularly water power, with an idea of determining what power was still available in New England, the cost to develop it and deliver it, the possibility of procuring power from Canada and what it would cost to deliver at the great industrial centers of New England. Finally, the committee was to report on other sources of power, chiefly power produced from coal and fuel oil, the cost of such power as produced under present conditions, the cost of generating it in large steam stations at tidewater, a survey of the available sources of coal and oil, and finally what could be expected from such miscellaneous sources of power as peat.

The report as now presented summarizes the findings of the committee and then gives in a large appendix the detailed results of its studies, including a complete tabulation of the streams of New England with their developed and undeveloped power. The gist of the committee's findings is given in the following summary and general conclusions:

Summary and General Conclusions—The industries of Massachusetts required in 1922 for their load of about 1,250,000 horsepower a total installed capacity of about 1,800,000 horsepower. Of this, about 300,000 horsepower was steam generating capacity in industries which required considerable steam for process work as well as for power.

The total energy used in New England in 1922 (except in steam locomotives) was about 7,500,000,000 kw.-hr., of which about one half was generated by the industries themselves and the other half by the public utilities. Of this total about 2,200,000,000 kw.-hr. was generated by water power. . . .

Judging from the past, the indications are that the total power requirements for New England ten years hence will be at least 15 per cent and possibly 20 per cent more than they are now. The same relative increase will hold for Massachusetts alone.

It is expected that on an average for the next ten years the load on the public utilities will increase each year by the following amounts, which are conservative:

For the Massachusetts-New Hampshire-Rhode Island group centering around eastern Massachusetts 90,000 kw. net additional capacity will be required and 190,000,000 kw.-hr, generated; for all New England 140,000 kw. and 300,000,000 kw.-hr.

This would mean that during the next ten years approximately 1,400,000 kw. of central station capacity must be added to that already existing in New England, in addition to replacements.

To electrify the additional railroad trackage, on which electrification would be desirable in the near future, would require about another 1,000,000 kw. of station capacity and 2,000,000,000 kw.-hr. per year after the electrification is accomplished. Such electrification of the railroads will depend upon their financial condition.

The question before us, and which we are now considering, is where can the necessary increase in power be obtained at reasonable costs.

There is undeveloped water power in New England at sites where 1,000 horsepower or more is available for 60 per cent of the time, about 860,000 horsepower or 640,000 kw. If it could all be fully developed for 50 per cent load factor this would require a station capacity of 1,720,000 horsepower or 1,280,000 kw., and would produce about 4,830,000,000 kw.-hr.

This would be sufficient to take care of the requirements for several years not considering the electrification of railroads, but unfortunately about three-quarters of this undeveloped power is in Maine, and under the existing laws cannot be exported. There remains in the rest of New England about 160,000 kw., equivalent to about 1,200,000,000 kw.-hr. Most of this power will not be developed in the near future because of the high cost of the development and of delivered current.

It appears that in all New England, including Maine, enough could be developed at reasonable cost to produce about 3,000,000,000 kw.-hr., and of this only a small portion is in the Massachusetts-New Hampshire-Rhode Island district, the area with which this report is mostly concerned. The balance (requiring interstate transportation) is not available, in the absence of legislation, or Supreme Court ruling, declaring electric power to be a lawful article of commerce.

The total from all such sources is relatively small compared with the total power requirements for New England's growth although important to individual plants.

In view of the above, it appears that the great bulk of the power for New England's additional requirements, particularly in the district centering about eastern Massachusetts, must come from the following:

(a) Large public service steam plants, located not far from the load centers and so as to obtain coal at the lowest rates, and containing large units and interconnected so as to run on high load factors at minimum operating cost; or

(b) A supplementing of such steam plants in New England by large water powers in Canada, if proper agreements can be made for the export of electric current.

The inference should not be drawn from comparisons of cost that have been made in the report that it is possible for water power to free the industries from their dependence upon a supply of coal; it can merely prevent the cost of power from mounting to continually higher levels, and it can lessen the hazard due to interruptions of the coal supply. If such water power were to be imported in competition with (instead of supplementary to) any and all steam power, its load factor would be reduced and its cost increased above that shown in the estimates.

The hourly load requirements of industries are so variable that even when tied together in large power systems the annual peak load is two and one-half times the average load. Water power from a distant source will best serve New England by being transmitted at as uniform a rate as possible, that is, on a high load factor, and delivering as much surplus power as can be absorbed by the shutting down of steam-driven units while water is wasting over the dams. Hence, such imported water power will be used to supplement the steam power, and one of the principal uses of the near-by steam plants will be to take the load peaks in regular and stand-by service.

Finally, central-station power, distributed by large interconnected systems, is the logical source of supply for over three-quarters of our growing industrial load. The cost of this power can be kept from steadily increasing only by the early importation of water power capable of relieving fuel-burning stations of a large share of the base load of the industries.

Hydro-Electric Power from Canada—Commenting on the increasingly important question of the possibility of obtaining part of the enormous quantity of hydro-electric power which can be made available in eastern Canada, the report says that power from the St. Lawrence River and the principal rivers of the Province of Quebec is estimated to be about 15,000,000 continuous hp., of which 10,000,000 is within 500 miles of Boston. Investigations have shown that it is entirely possible to transmit this power without incurring excessive loss from the nearer blocks of power available in Quebec, 5,000,000 hp. of which is on the St. Lawrence River at three sites located between Ogdensburg, N. Y., and Montreal, and are consequently about 250 miles from central Massachusetts. From a physical standpoint, there is no reason why these plants cannot be developed so that they will produce from 20,000,000,000 to 25,000,000,000 kw.-hr. yearly, but the committee is of the opinion that as this power is tied up with the projected canalization of the river, no power could be hoped for from the St. Lawrence in less than ten years.

For this reason the committee has turned to the other principal rivers of the Province of Quebec to ascertain power for New England, namely, the Ottawa, St. Maurice, Saguenay, and St. Francis. The total available continuous power of these rivers is about 5,000,000 hp., of which about 700,000 is now developed and about 600,000 is under construction. The sixteen principal undeveloped water-power sites on the Ottawa, St. Maurice, and Saguenay River have an estimated possible continuous output of about 2,500,000 hp., all of which lies within a radius of about 450 miles from the approximate center of power demand in New England. This 2,500,000 hp. of continuous power is equivalent to about 12,000,000,000 to 15,000,000,000 kw.-hr. of delivered energy and would call for an installation of about 5,000,000 hp. of power equipment on a basis of 50 per cent load factor.

Cost of Canadian Water Power for New England—The committee states that sufficient information is available regarding the physical characteristics of the power sites in Eastern Canada to determine that they can be developed at a reasonable cost. Detailed studies and estimates of these sites which have been made indicate that power could be produced at the power house for an *average* cost of about 0.35c. per kw.-hr. generated, if the plants were equipped with machinery to handle the output on a 50 per cent load factor basis.

The committee states that considering the distance over which this power would have to be transmitted (from 275 to 425 miles), and the cost of transmission lines, it would not be economical to attempt to bring any of this power into Massachusetts, unless in quantities approximating 1,000,000,000 kw-.hr. per year within a year or two after such lines are completed. It is essential that a sufficient market be developed to fully utilize the output of one or more of the plants. The cost of the necessary transmission lines and other auxiliary equipment for a 1,000,000,000 kw.-hr. project on a 50 per cent load factor basis, together with the loss of power in transmission and delivery to customers, would make the cost of power, delivered to the users of large quantities in eastern Massachusetts, probably not over 1½c. per kw-hr. This is the average cost on a load factor of about 50 per cent. It does not include any allowance for the increased operating cost per kw.-hr. of the portion of an interconnected system whose load factor is less than 50 per cent.

Further attention is called to the fact that these figures do not allow much for developing the business, but assume that practically the full capacity can be marketed in about two years after the completion of the undertaking. Such a tremendous amount of power might not be marketed completely in such a short time, with the result that the excess carrying charges during the period of incomplete use would increase the cost.

Important Considerations—Other considerations not generally appreciated in a question of this kind when a project of this size must be financed are enumerated by the committee. They are: (1) Can 1,000,000,000 or more kw-hr. of energy be marketed in New England yearly within a reasonable period of time after the necessary physical structures are completed? (2) Will the Canadian and provincial governments give assurance that this amount of energy will be allowed to be transmitted into New England for a sufficient period of years, so that the cost of the undertaking can be amortized at a reasonable rate? And (3) Is it a good policy for New England to make itself dependent upon a foreign source of power supply for even a portion of its demand?

Answering these questions, the committee finds that its studies indicate that the amount of 1,000,000,000 kw-hr. could be marketed within a reasonably short period after it became available. In answer to the second question it finds that the average increase of power demand in eastern Canada is about 51,000 hp., which, if it were maintained, would take about 80 years before the remaining 4,000,000 hp. of undeveloped water power still available in southern Quebec other than the St. Lawrence River, would be utilized. In the meantime, one or more of the great power possibilities on the St. Lawrence will beyond doubt be developed, and this New England load could be shifted if Quebec found itself short of power, which is, however, unlikely as the present rate of increase is abnormal.

As to the reasons in favor of the Province of Quebec permitting this power to be exported, the committee finds that the capital expenditures in developing the power would add to the taxable resources of Quebec and that, without question, much of the power that is now wasted on account of the load factor condition could be marketed by proper interconnection of the various Quebec transmission systems with the New England system, that the gain due to diversity of stream flow would save a tremendous expenditure in auxiliary steam plants or reservoir developments, or both. Moreover, Canada should be interested in the conservation of coal in the United States, and certainly is interested in the cost of coal. 1,000,000,000 kw.-hr. from waterpower will save at least 1,000,000 tons of coal at the mine per year, and since the price of coal to a great extent will always be governed by the demand, it is fair to assume that Canada will obtain a direct benefit from the saving in coal consumed in New England.

As to the third question, the committee says that the recorded history of friendship and mutual interest in all things which have always existed between Canada and the United States would seem to be sufficient answer. Should this friendship cease, it would be such a calamity that the question of power supply for New England would be very uninteresting indeed.

From Job and Office

Hints That Cut Cost and Time For the Contractor and the Engineer

Recommended Practice for Sandblasting and Painting Steel Bridges

By F. G. Schworm
Assistant Engineer, Bureau of Highways, Philadelphia, Pa.

When the city of Philadelphia undertook on a large scale the painting of its bridges it was found that there were little written data as to equipment required and probable cost of sandblasting, the method of cleaning the structure decided upon. Inquiries received from numerous sources since the work started indicate a widespread interest in sandblast work for such purposes, so Philadelphia's experience may prove generally informative. Sandblasting was chosen over chipping hammers, wire brushes, and other paint removers because of its superiority in cleaning effectively all parts of the steel, pits as well as high spots.

The Walnut St. bridge, the first structure to be cleaned and repainted, is about 2,400 ft. long. Three river spans of 123 ft. each are deck Pratt trusses carrying a buckle-plate floor supported on 15-in. I-beams spaced at 3-ft. centers and resting on top of the trusses. The approach spans are plate-girder viaducts with the floor the same as in the river span. The work naturally divided itself into the following: Scaffolding, cleaning, first coat, and second coat.

Scaffolding—The only considerations present in scaffold erection for bridge painting that are lacking on scaffold work for any construction job concern themselves with reuse of scaffold sections and consequent economy in those cases where the bridge is long. In the case of the Walnut St. bridge, for the space between girders, needle beams were placed on the bottom flanges and 2x12-in. planks were then placed on the needle beams. For the portion overhanging the outside girders the needle beams were hung by ⅞-in. rods. This scaffold was easily moved ahead as the work progressed. No rope was used.

Cleaning—Three separate operations were included in cleaning: Chipping, drying the sand, and sandblasting. Where steel is but lightly rusted no chipping is necessary, so the number of men chipping ahead of the blast varies with the condition of the steel. The Walnut St. bridge job was equipped with hand chipping hammers and with a light air chipping gun. On one portion of the work over the railroad tracks, locomotive gases had corroded the steel so that several men were necessary to loosen the scale ahead of the blast.

When dry sand is not procurable, the cheapest method of drying when weather permits is to spread the sand in the sun. In damp weather artificial means are necessary. On a large job, it will take one man's entire time drying sand for the blasting machine.

The heavy equipment for sandblasting consists in the air compressors and the sandblast machine. When the Walnut St. job was begun a portable gasoline-driven compressor was used with a 6-in. bore and a 6-in. stroke, a piston displacement of 118 cu.ft. per minute, and air delivery at 100 lb. pressure. This machine performed the work well within its capacity, but was found inadequate to keep ahead of the large gang it was desired to keep on the bridge. Therefore, the smaller machine was replaced with an 8x8-in. cylinder and a displacement of 210 cu.ft. These two were worked together for a time until a duplicate of the larger machine was purchased and the small one taken to another job. This larger type machine is recommended to be used on large jobs. The sandblasts used were of the single-chamber type of 1,000-lb. capacity each. The figure herewith shows the arrangement of compressors and sandblasts found most satisfactory.

TABLE I—COST OF PAINTING EAST APPROACH WALNUT STREET BRIDGE

Feature	Foreman	Labor	Material	Equipment Cost	Equipment Depreciation	Total	Area Sq.Ft.	Cost per Sq.Ft.
Scaffold	$30.90	$518.80	.....	.....	$95.00	$644.70	65,000	$0.010
Cleaning	43.70	732.50	.....	$306.61	235.00	1,317.81	65,000	.020
1st Coat	37.50	629.38	369.25	10.00	2.00	1,048.13	65,000	.016
2nd Coat	32.50	545.00	177.00	6.75	1.00	762.25	65,000	.012
	144.60	2,425.68	546.25	323.36	333.00	3,772.89	65,000	.058

Sand—48,600 lb. or ½ lb. per sq.ft.
1st Coat—161 gal. or 400 sq.ft. per gal.
2nd Coat—151 gal. or 430 sq.ft. per gal.
1st Coat—126 lab. da. or 517 sq.ft. per man per day.
2nd Coat—109 lab. da. or 595 sq.ft. per man per day.

The crew operating the sandblasts consists of four men: One nozzleman and one engineman to each compressor and sandblast. An efficient signaling system between nozzleman and engineman was secured through the use of a rope passing through pulleys from the nozzleman to a gong at the compressor. Pressure of at least 80 lb. at the sandblast is required. One hundred pounds is desirable. Below 80 lb. the sandblasts were not efficient and the increased efficiency as the pressure rises above 80 lb. is very noticeable.

Nozzles from ⅛ in. to ⅜ in. in diameter were tried, but the best results were secured with a nozzle from ¼ to ½ in. The sand used must be clean, hard, sharp, and coarse. Experience on the Walnut St. job has resulted in the following specification for sand:

Retained on a 10-mesh sieve	Not over 5%
Passing 10-mesh, retained on 20-mesh	80 to 100%
Passing 20-mesh sieve	Not over 15%

Painting Coats—As much data are available from standard handbooks on painting, little need be said in this connection. However, the first coat was red lead and applied by brushes. The second coat was a bottle green and applied partly by brush and partly by spray. Data on the comparative cost of brush work and spray work indicated that the spray reduced labor costs and increased material costs, the extra paint used practically offsetting the reduction in labor so that the per square foot cost for either method was approximately the same.

The costs below are for day labor hired by the city:

Labor	$0.45	per hour
Engineman	.45	per hour
Painters	.625	per hour
Nozzleman	.625	per hour
Red lead paint	2.25	per gal.
Bottle green paint	1.18	per gal.

Table I shows unit costs for the first five spans of the east approach, a section quite generally rusted but not deeply pitted. In some places it was necessary only to lightly clean the old paint; in others, the old paint was entirely removed, so average conditions are represented.

TABLE II—COST OF SANDBLASTING WALNUT STREET BRIDGE

Job	Foreman	Labor	Compressor Hours	Gasoline and Oil Supplies	Sand Lbs.	Sand Cost	Depreciation	Total Cost	Area, Sq.Ft.	Unit Cost	Lbs. of Sand to Clean 100 Sq.Ft.	Sq.Ft. Cleaned per 8 Hr. Day per Compressor	Remarks
A	$15.00	$198.20	117	$92.10	34,440	$129.15	$80.00	$514.45	12,525	$0.041	275	856	West approach Entire surface rusted Full cleaned
B	73.00	549.36	.....	230.21	105,680	396.30	350.00	1,598.87	38,000	.042	278	...	River spans Entire surface rusted Full cleaned
C	6.00	78.20	.....	17.75	7,440	27.90	30.00	159.85	3,070	.052	242	...	East approach—over railroad Extremely bad condition Full cleaned
D	238.35	3,796.36	1,300	1,003.23	264,700	991.85	1,050.00	7,079.79	280,700	.025	94	1,728	West approach Average condition Spot cleaned

On some of the work now being done scaffold cost is being reduced to near ¾c. per square foot. The surface covered per gallon for the first coat has also been increased to an average of 450 sq.ft.

Table II gives the costs of sandblasting under different conditions. It should be noted that the cost of scaffolding is not included. Job A covered eight working days with two 8 x 8-in. compressors working, and was a job whereon old paint was entirely removed but where the rust was not deep. The area cleaned per day per compressor varied from 700 to 1,025 sq.ft.

Job B covered about seven weeks under conditions similar to job A. One 6 x 6-in. and one 8 x 8-in. compressor were used.

Job C covered three working days, one 6 x 6-in. and one 8 x 8-in. compressor working, and the job being over railroad tracks where the steel had been exposed to locomotive gases. Steel was heavily rusted and pitted; an unusual amount of chipping and loosening of

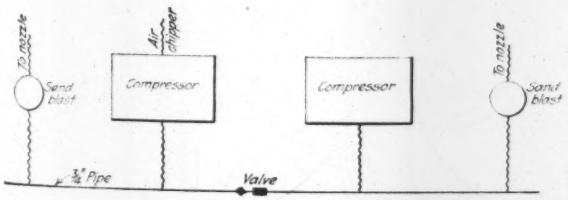


FIG. 2—BEST ARRANGEMENT OF EQUIPMENT

the scale was done before blasting. This section represents about the worst conditions.

Job D covered four and one-half months. Two 8 x 8-in. compressors were working. The surface was "spot cleaned," that is, the old paint where good was not removed. This is the usual condition.

Allowance should be made in these costs for the fact that the work was done by city forces on hourly pay. By putting the work on a piecework basis a contractor should cut these costs considerably.

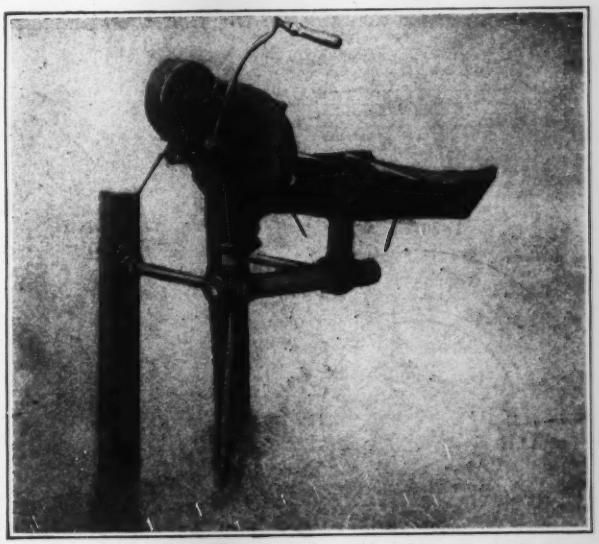
Inexpensive Forge for Small Jobs

By Chester Lynndelle
Trenton, N. J.

On small construction jobs and in farm building work there often occurs the need for a small forge—a want usually filled by some standard type of more or less portable unit which, when not in use, is somewhat bulky and awkward to store. One contractor has solved the cost problem as well as the one of storage by buying only the blower unit and improvising the remainder of his forge, including the legs, from pipe. His bill of material may be secured very cheaply from any plumbing supply dealer, and runs as follows:

1 2-in. three-way tee	1 2-in. flange (for forming tuyere base)
1 2-in. three-way ell	2 2-in. plugs
3 2-in. x ¾-in. bushings	3 2-in. nipples
3 ¾-in. pipes to suit	2 ¾-in. flanges
1 2-in. pipe as desired (connecting blower and tuyere)	

Two stakes are driven into the ground where the forge is to stand, the various pieces of pipe fitted



PORTABLE FORGE OF INEXPENSIVE MAKE

together as shown in the illustration, and the two ¾-in. flanges attached to the stakes with ordinary wood screws. The entire outfit weighs much less than an ordinary portable forge of the same heating capacity,

and collapses to a bundle only slightly larger than the blower unit.

The draft pipe may be readily cleared of cinders by removing the plug at either end, while the standard of ¾-in. pipe, being open at the bottom, provides drainage and thus eliminates the danger of a frozen draft line, so often encountered during a winter job when using a forge with the usual type of draft pipe without outlet.

New Design for Manhole Covers For Manhattan Borough

By H. W. Levy
Engineer-in-Charge, Division of Design, President of the Borough of Manhattan, New York City

A NEW DESIGN for covers has been made for the sewer manholes in the Borough of Manhattan, New York City, to prevent rattling and to withstand the impact from heavy traffic. It has several novel features which may be observed from an inspection of the drawing herewith.

The cover vent holes are placed at 45 deg. to the vertical with their lower openings coming alongside of the circular vertical rib on the underside, so arranged that sticks cannot be poked through without being broken off into very short pieces. The vertical radial ribs on the underside of the cover are directly beneath the unbroken radial upper ribs on the top surface and thereby the full effective depth of the metal is used to resist the bending strains.

The cover is designed for a live-load of 800 lb. per linear inch of tire tread, with a maximum concentration of 13,000 lb. To prevent rattling or displacement the under edge of the cover for a distance of 1½ in., and the cover seat, are machined to a plain surface. Clearance between head and cover is reduced to ¼ in. and the edges of the cover must be trued to a 90-deg. angle. The center circular depression on the under side of the head is used to support a danger flag while it lies in the street bottom side up when off the manhole.

From Job and Office

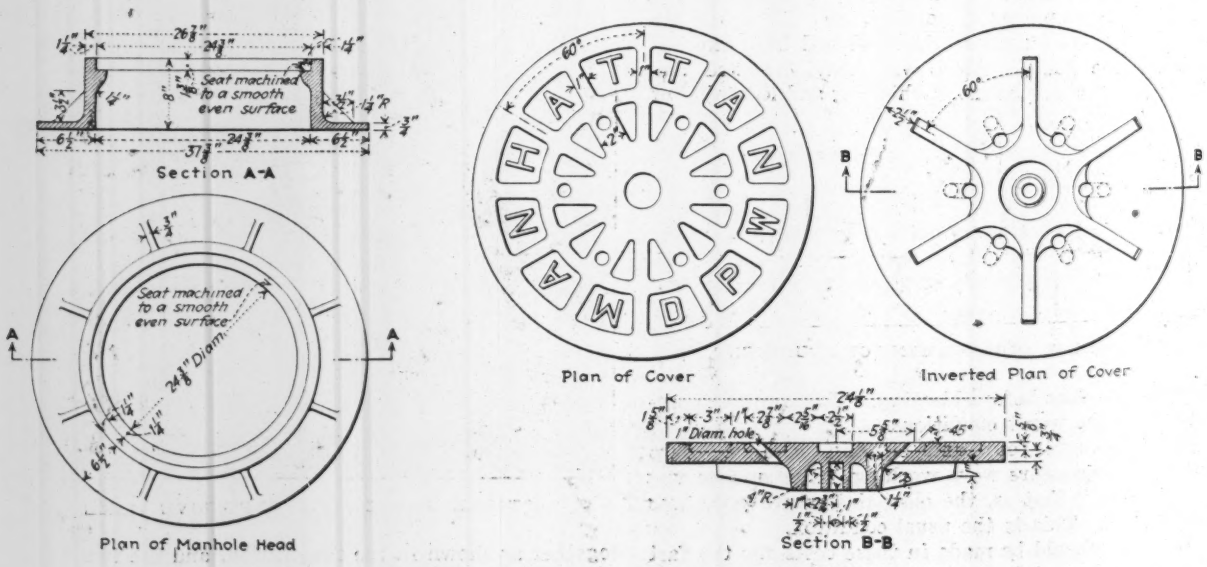
Hints that Cut Cost and Time

Replacing Engine Turntables Rapidly at Pennsylvania R.R. Terminals

RENEWAL OF railway turntables at busy engine terminals involves careful planning and rapid work in order to avoid interference with the operation of the terminals. At several points the Pennsylvania R.R. has replaced old 75-ft. with new 110-ft. turntables and details of two recent cases carried out in 13 hr. 20 min. and 9 hr. 15 min. are given herewith by courtesy of A. C. Shand, chief engineer of the road.

Southport Terminal—With the use of heavier and longer locomotives on the Elmira division it became necessary to replace a 75-ft. turntable with a 110-ft. three-point support turntable at the engine terminal at Southport, N. Y. This renewal was carried on in conjunction with the building of seven additional 120-ft. stalls to the enginehouse. The engines undergoing repairs were set in the enginehouse on tracks that were to be placed out of service, so that at all times the master mechanic had use of all tracks in the house.

In excavating the enlarged pit, a railroad ditcher or small steam shovel was used on the existing tracks. This allowed the loading of air-dump cars, which were unloaded at a new fill. The same work train was used to handle material to and from the new enginehouse. As the excavation at one track was finished, trestle bents and stringers were erected to carry the track to the line of the old pit, and this work followed the excavation so closely that no track in the enginehouse was out of service for more than 24 hr. When a section covering three tracks had been excavated, forms were placed and the new circle wall and circle rail foundation were poured. The same set of forms was used to complete the circle wall. Some of the timber bents are



DETAILS OF SEWER MANHOLE OF NEW DESIGN

From Job and Office

For Contractor and Engineer

shown at the left in Fig. 1, in front of the new circle wall.

Owing to the greater depth of the new table, it was necessary to lower the pit floor about 30 in. Water was encountered at a depth of 20 in. and it was necessary to install a steam siphon. To strengthen the center foundation, an additional row of piles was driven around the outside and a reinforced-concrete cap was poured. As the old stone center block was to be removed, a precast reinforced-concrete center block was prepared.

Upon arrival, the new turntable was unloaded on car trucks about 450 ft. from the final location on a track leading to the pit. Here the deck was placed, rails were laid, the steel framework for the overhead current collector erected, the end trucks attached, and the operator's cab and control apparatus installed. The tractors were also installed temporarily in order that all electrical connections might be tested before the turntable was placed, but they were removed before placing the table in position.

This new 110-ft. turntable was installed on Jan. 20, 1924. An 11-ton derrick or wrecking crane was placed on the south side of the pit on a track opposite the one on which the new turntable stood. A locomotive crane with two gondola cars on each side of it was placed on the west side of the pit to remove the falsework supporting the tracks. At 4:12 a.m. this work was completed and the 75-ft. table was placed out of service. Its tractor was first removed and lifted out by a 100-ton derrick or wrecking car on the north side of the pit. The rails were then removed, the table was placed in an east-and-west position, and the ties were removed by the locomotive crane on the west side.

While the ties were being removed falsework was being erected in the pit from the derrick on the north side to the old table. The derrick then moved out on the falsework, picked up the old table and placed it on car trucks set on an adjoining track, whence it was moved away by a yard engine. The derrick was then used in moving the old mechanical center and the center stone. After the surface of the foundation had been bush-hammered to give an even bearing, a thin coat of mortar was spread and the new reinforced-concrete center block was set in place. The mechanical center block was then placed.

While this work was progressing, falsework was being constructed from the derrick on the south side of the pit to that which had been built for the removal of the old table. At noon the new table was moved on the car trucks from the assembling point onto the falsework in the pit, between the derricks. It was then lifted from the trucks and placed on cribbing on the circle wall. The car trucks and falsework were then removed and finally, the table was again lifted by the derricks, swung into position and lowered onto the center, as shown in Fig. 1. This work was completed at 3:22 p.m. Then the installing of the electrical connections was started. The overhead line from the towers to the collector on the table was also installed and the tractors, placed on the circle rail by the derrick, were connected. The new turntable was ready for service under its own power by 5:32 p.m., after service had

FIG. 1—NEW 110-FT. TURNTABLE BEING PLACED AT ELMIRA, N. Y.; PENNSYLVANIA R.R.

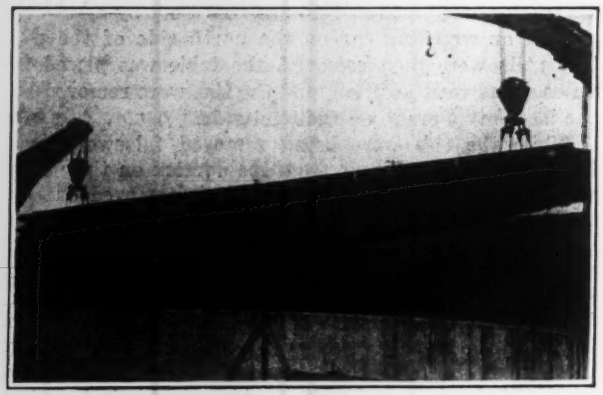


FIG. 2—RENEWING TURNTABLE AT PHILADELPHIA
Above; wrecking cars lift out old turntable and place it on cars. Below; lowering new turntable into position.

been interrupted only 13 hr. and 20 min. The weight of the new turntable, complete, was about 80 tons, while that of the old table was 42 tons.

An important feature of this work, from the operating standpoint, was that notwithstanding an exceptionally heavy movement of cars through Southport yard, all engines were despatched in such a manner that no delay to outbound trains occurred. This was accomplished by making a study of the traffic for a number of days previously to decide the approximate number of trains despatched in each direction. The outbound engines were then headed in accordance with the prearranged schedule. Just previous to the abandonment of the old table, a study of the road movement in progress was made to determine how many engines then on the road would be headed in each direction. The engines which were in enginehouse territory were then turned so that those on hand and those on the road would be headed in the predetermined ratio when the table was finally placed out of service. Thirty engines of all classes were handled during all of this time.

The new turntable was installed at a cost of about $55,000. A force of 115 men, including foremen, carpenters, helpers and laborers was engaged in the work, under the direction of C. J. Flayhart, master carpenter.

Philadelphia Terminal—Still more rapid work was done at the 46th St. enginehouse, Philadelphia, on Feb. 27. At 7 a.m. the old 75-ft. turntable was put out of service and at 4:15 p.m. the new 110-ft. turntable was placed in service, the total elapsed time being 9 hr. 15 min. Both turntables are of deck girder construction; the old one weighed 115,000 lb. and the new one 189,500 lb. Both were centered at the same point, but the new table is of the three-point bearing type.

From Job and Office

Hints that Cut Cost and Time

In the preparatory work, the new pit wall was constructed under traffic, the old wall being removed and the various tracks taken care of by trestling between the two walls. The new table was assembled approximately 500 ft. from the pit, and was placed on standard car trucks. After the last engine was turned at 7 a.m., a locomotive crane with 50-ft. boom removed the falsework, cribbing and trestling, which had supported the tracks during the construction of the new pit wall. The new table on its trucks was then moved onto the old table (instead of onto blocking as at the Southport terminal) and unloaded to the side by two wrecking derricks. Then the old table was lifted off center and moved to the other side on cribbing, whence it was afterward slid over to the side of the pit by the two derricks and loaded on cars for removal. These operations are shown in Fig. 2.

With the pit empty, the old center was cut down to the proper elevation and the new precast reinforced-concrete center block was set in place (see Fig. 3). The new table was then placed on the center by the two wrecking derricks. The old center was removed at 10:18 a.m., the foundation cut down and leveled off and the new center set at 1:15 p.m. The new turntable was placed on center at 2:23 p.m., with the ties and rail in place. After the table was placed, one tractor was coupled up and made ready for service at 3:42 p.m. (see Fig. 3), and the other tractor at 3:55 p.m. The electrical connections for operating the table were completed and tested at 4:03 p.m.; one of the derricks was turned on the table at 4:15 p.m. and the table was then placed in service. Each operation was set up on a pre-arranged schedule and the work carried out practically as scheduled.

The new table was built by the McClintic-Marshall Co., Pittsburgh, Pa.; the mechanical center, tractors and electrical equipment were furnished by the Altoona shops of the railroad. This work was under the supervision of J. O. Hackenberg, superintendent; M. Lipman, division engineer; and W. R. Gantz, master carpenter, the last being in direct charge.

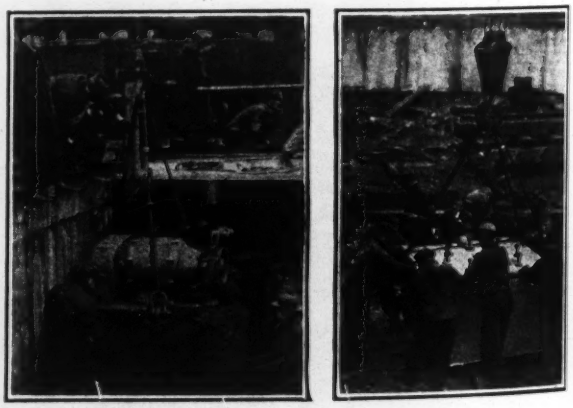


FIG. 3—NEW TURNTABLE AT PHILADELPHIA
At right; place new center block. At left; attaching one of the tractors.

From Job and Office

For Contractor and Engineer

Lead Pipe for Cement Floors

By William Wallace Christie
Consulting Engineer, Ridgewood, N. J.

In JUNE, 1902, when specifying a concrete platform for a factory building, I called for 1-in. inside diameter lead pipe thimbles 1 in. long to be set in the finishing coat, to give a more satisfactory wearing surface, and one which would be rough enough to prevent slipping. The results have proved very satisfactory. The top coat of cement was all sand and cement and after being worked down to a smooth surface, the thimbles were set 4 in. c. to c. and hammered down through the material, after which the surface was properly leveled and worked down with the trowel in the usual manner.

This in my opinion is a cheap and satisfactory method of providing a wearing surface. Old lead pipe can be used, and can be readily cut with an ordinary saw. The soft lead sticks to leather and has proved itself a good preventive of accidents which often happen on the glossy surface of cement floors with a hard finish.

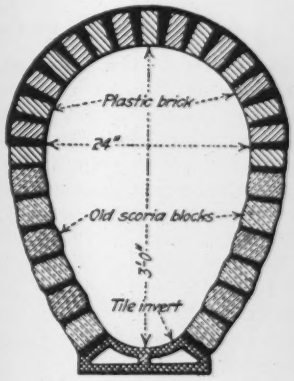
Scoria Blocks Replace Brick in Sewers

SUCCESSFUL use of old scoria blocks in the construction of sewers at Montreal, Que., is reported by the Department of Public Works of that city. The blocks are used considerably in the construction of medium-sized sewers as a substitute for brick in the portion below the spring line.

For an egg-shaped sewer 2x3 ft., scoria blocks are used from the tile invert on each side to within one brick thickness of the spring line. That is, upon the invert are placed six rows of blocks which replace eight rows of plastic brick—about 70 bricks per lineal yard, or equivalent to 48½ per cent of all the brick used in the regular 2x3-ft. sewer. The quantity of mortar used is about the same in both cases on account of the voids between rows, though a thicker mortar is necessary when assuring a bond between scoria blocks.

The cost of laying is about the same. The bricklayer becomes fatigued quicker when laying scoria blocks than when laying ordinary brick on account of the difference in weight, for an ordinary scoria block weighs 13 lb. and a brick, only 5. Therefore, the saving per lineal yard of a sewer of the dimensions herewith shown would be the cost of 70 bricks, less the cost of cleaning and transporting 52 scoria blocks if the blocks cost nothing. The city of Montreal charges $15 per thousand blocks. Assuming a cost of 1c. per block for transportation and $3.75 for cleaning 1,000 blocks, the cost will be $28.75 per thousand. The cost of the brick which the scoria blocks replace is at present about $34.46 per thousand delivered at the site. This makes a saving of $6.71 per 19.2 lin. yd. of a 2x3-ft. sewer, which figure is almost 35c. a lineal yard. Scoria blocks can only be used from the invert to the springing line because of the more porous nature of the brick and the possibility of scoria blocks dropping from the arch under vibration.

Manholes man be constructed entirely of old scoria blocks except for the fact that voids on the outside circumference are filled with pieces of brick bonded with cement mortar, the blocks being too difficult to break up. A manhole 11.5 ft. high requires about 1,200 bricks, 12 bags of cement, and 2,500 lb. of sand. The same manhole would require 820 scoria blocks, 100 bricks to fill the voids, ten bags of cement, and 200 lb. of sand. Quoting $15 per thousand blocks, the saving would come to about $9.



SEWER PARTLY BUILT OF SCORIA BLOCKS

Hopper Gate Opened by Truck Body

IN THE 5¾-mile extension of the new Los Angeles Harbor Truck Boulevard recently completed, a central materials plant was located about midway and materials were delivered in both directions in dry batches to the mixers. For delivering the materials Fords with dump bodies designed to accommodate a 5-sack batch of 1:2:4 concrete were used. As many as 20 trucks were used when the haul was 2½ to 3 miles.

A feature of this operation was the arrangement of the trip on the bottom of the hopper beneath the measuring platform whereby the radial gate of the hopper was pushed open by the rear end of the truck body as it backed under the hopper. The gate was closed by a counterpoise as the truck pulled out. No cover was used on the truck bodies as there was neither wind nor rain enough to disturb the cement during the progress of the work.

The paving was done by contract under the general direction of George W. Jones, county highway commissioner, from whom the foregoing information was secured.

State Control of Concrete Building Blocks

With the rapid increase in the use of concrete blocks for building construction in Wisconsin, the state building code has been revised in the interest of public safety, as shown by the following quotation from the report of the Industrial Commission division of the State Department of Engineering:

Manufacturers of concrete block have sprung up all over the state. The result was an unsafe building unit, and the demoralizing of the legitimate business of large and small concrete block producers. The building code was changed to require: (1) The marking of all concrete block and tile with a distinctive permanent mark or brand; (2) the testing of all concrete block and tile to prove compliance with existing standards of strength and porosity. There has been considerable improvement in the quality of concrete products since the adoption of the above changes. However, there are nearly 500 concrete block makers in Wisconsin and these have not all been effectively reached.

Offers for Muscle Shoals Property Summarized

Résumé of Bids Submitted by Ford, Association of Southern Power Companies, Union Carbide Co., and Elon H. Hooker

IN VIEW of the fact that early action on one of the bids for the government-owned property at Muscle Shoals is possible in Congress, public notice is more or less centered on the various offers which have been made for lease or purchase of power and other property. Offers for the property were made first to the Secretary of War, inasmuch as the War Department controls the properties and had requested bids. The Secretary of War referred these offers to Congress with a request for legislation which would authorize the War Department to execute the necessary contracts. Bids were referred to the House Committee on Military Affairs, and the Senate Committee on Agriculture. A short history and a statement of the salient features of each of the principal bids, prepared by H. F. Sedgwick, clerk of the House Committee on Military Affairs, are herein contained.

Ford Offer—Henry Ford submitted an offer for the Muscle Shoals property early in 1922 and on June 9 of that year the House Committee on Military Affairs reported favorably on H.R. 11903, the bill being in effect the Ford offer, though it contained an amendment which eliminated the Gorgas steam plant. No action was taken on this bill in the House before adjournment, so soon after December, 1923, that bill was revived in the form of the McKenzie Bill, known as H.R. 518, with the so-called Madden amendments. The House passed this bill on March 10, and it is now before the Senate.

By Ford's offer, a corporation with a cash capital of at least $10,000,000 is to be formed to execute his agreement, stock and securities to be owned and controlled by American citizens only. This corporation proposes to lease dams Nos. 2 and 3, with all necessary appurtenances, for 100 years. The annual rental for the lease is to be on the basis of 4 per cent of the actual cost of the construction work, not including the $17,000,000 spent on dam No. 2 prior to May 30, 1922.

The Ford corporation proposes the purchase for $5,000,000 of nitrate plants 1 and 2, the Waco quarry, and a steam generating plant to be provided by the United States as a substitute for the Gorgas plant, which was sold to the Alabama Power Co. The cost of this substitute steam plant is to be not in excess of $3,472,487. The corporation also agrees to manufacture each year commercial fertilizer containing at least 40,000 tons of fixed nitrogen and at a profit of not to exceed 8 per cent of the cost of manufacture.

To meet these conditions, a board shall be created to consist of members nominated by the national farm organizations, the President of the United States, and the Ford company, the representative of the Department of Agriculture to sit in an advisory capacity without a vote. The Ford corporation also agreed to determine by research whether cheaper and better fertilizer can be manufactured.

Power Company's Offer—By the terms of H.R. 6781 a corporation is to be formed with a capital stock of $15,000,000, the company to be owned and controlled by American citizens. This is the basis of the offer made by a group of southern power companies.

This corporation proposes to lease dams Nos. 2 and 3 for a term of fifty years, the average rental for the leases to be on the basis of 4 per cent of the actual cost of construction, except for the fact that if dam No. 3 is built by the power companies' organization, the provisions of the Federal Water Power Act will apply. This corporation proposes to lease nitrate plant No. 1 for $1 a year and is to maintain nitrate plant No. 2 in readiness for the production of explosives at the cost of the United States. It will produce annually at nitrate plant No. 1 fertilizer with a content of 50,000 tons of fixed nitrogen, as rapidly as there may be commercial demand for it. The price is to be production and sales cost, plus a profit of 8 per cent. A board appointed by the Secretary of Agriculture and the company is to supervise prices and distribution of the fertilizer. A fund of $1,000,000, to be paid in ten annual installments of the power companies, is to be expended under the direction of the government in electrochemical research in the interest of agriculture and national defense. The corporation will furnish for the manufacture of fertilizer the maximum of 140,000 hp. and will sell the remaining power developed to the people.

Union Carbide Co. Offer—The offer made by the Union Carbide Co. concerns itself only with nitrate plant No. 2 and the Waco quarry, the assumption being made that the hydro-electric installation will be operated by other concerns. Lease of nitrate plant No. 2 and Waco quarry is requested for a period of fifty years at an annual rental of $150,000 for the nitrate plant and a royalty of 5 per cent on a ton on all stone taken from the quarry. The Union Carbide Co. proposes to produce fertilizer with a nitrogen content of upwards of 20,000 tons a year. It agrees to sell this fertilizer as the government may direct, at a profit not exceeding 5 per cent and a maximum profit of $2 per ton. It also agrees to do research and experimental work.

Elon H. Hooker and Associates—The offer made by Elon H. Hooker and associates contemplates the formation of a corporation with a cash capital stock of $1,000,000, which will lease the nitrate plants and the hydro-electric power plant and operate them at the expense of the United States for a term of fifty years. The corporation is to be permitted to earn an annual net profit of 8 per cent of the current sales price of all fertilizers manufactured by the corporation during the year. Agreement was also made to continue and extend fertilizer production and sell the surplus power produced.

From the net annual earnings of the corporation on the operation of the power plant, interest on preferred stock will be paid, a fund for research and betterment work created, and another fund to amortize the cost of dams, etc., the remaining profits to be divided between the United States and the common stock holders in the following manner:

For the first ten years the United States is to receive two-thirds of all profits resulting from the sale of fertilizer and power, and thereafter three-quarters of the profits; out of its profits the corporation will amortize the cost of dam No. 2 (excepting the navigation facilities), the cost of the steam plants, and the cost of dam No. 3. A committee of three, two to be appointed by the corporation and one by the Secretary of War, is to have advisory powers in all matters connected with properties and the sale of the products.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

A Defense of Paving Engineers

Sir—It is apparent in the letter of Troy Carmichael, city engineer of Helena, Mont., in *Engineering News-Record*, March 6, 1924, p. 418, that he has very little respect for the ability of present-day highway engineers.

The accusation that engineers engaged in city, county and state highway construction, when confronted with the expenditure of large sums of money, adopted the concrete type of pavement owing to their lack of experience with other types of pavement of proven value, is an unjust criticism of a large majority of the able men of the profession who have produced, and are to this day producing, excellent results in pavement design and construction.

It is quite true that there are differences of opinion as to methods of design and construction, not only of concrete pavement, but of all types of pavement. Fortunately, this is inevitable. Were it not so, road engineers would fall behind in the progress and advancement of the profession.

Experienced engineers as a general rule are not inclined to be hasty in accepting new methods or types of construction without just and adequate reasons for adopting them. Surely, when such a vast mileage of concrete pavement has been and is now being, constructed, it cannot be said that they have erred in their judgment.

Los Angeles, Calif., March 27, 1924. PAUL E. KRESSLY, Consulting Engineer.

Dragline Ditches and Pipe Pressures

Sir—Certainly much good will come from a more widespread understanding of the fact that many sewerage and drainage lines have been constructed having a factor of safety of less than unity. In the drainage of irrigated land the depths to which clay and concrete drain tile are laid are comparable to the depths of sewer lines, and very often are great enough to cause trouble by reason of the collapse of pipe from external pressure.

The charts given by Mr. Lenth in *Engineering News-Record*, March 27, p. 533, make it possible quickly and easily to apply the method of computing the pressure on pipe worked out by Dean Marston and others of the Iowa Engineering Experiment Station. However, the statement contained in the next to the last paragraph of Mr. Lenth's article as to the hazard from the use of dragline excavators in sewer and drainage work indicates that there is danger of extending Dean Marston's formulas and conclusions to conditions not covered either by his mathematical treatment or his experimental work. A footnote on p. 32 of Bulletin 31 of the Iowa Experiment Station, by Messrs. Marston and Anderson, is as follows:

"For an extremely wide ditch this principle would no longer hold sufficiently correct."

A study of Table 11 of the same bulletin will show that in only one case was the width of trench as great as the maximum width as recommended by Mr. Lenth and in no case as great as that given by the Metcalf and Eddy formula or the old rule.

Evidently, there is a point somewhere at which the load on a pipe stops increasing with the width of the trench. It is also evident that the width of trench which will produce a maximum load on a pipe of a given size will vary with the character and condition of the soil. In the drainage of irrigated lands it is quite customary to lay tile below the water table and with water standing or flowing in the trench. Where this is true and the soil is loose or sandy it is possible that the width causing a maximum load will be not far from that used in ordinary practice with trench machines, and less than the width used where dragline excavators are employed. Within the rather narrow range of relative widths of trench covered by the Iowa experiments the agreement between the loads as calculated and as weighed is remarkable. However, as noted above, the trenches were comparatively narrow in all cases and the results give no indication as to the widths to which the formula may safely be extended.

In many cases, especially in small drainage districts where both open and closed drains are used, it is more economical to use a dragline excavator for digging trenches for pipe than it would be to bring in a trenching machine. In such cases the use of the dragline should not be prohibited on account of the extra width of trench resulting, until it is shown that such trenches actually do cause excessive loads.

M. R. LEWIS, Associate Professor of Agricultural Engineering, University of Idaho.

Moscow, Idaho. April 12, 1924.

Men in Minor Engineering Positions

Sir—The writer has spent a number of years as one of those men who make up what is commonly called the "engineer corps," which in this instance is meant to include, chainman, rodmen, instrumentmen, draftsmen and field or resident engineers. In analyzing any one group, there were always a number of men who knew their work and performed it well; while at the same time there appeared to be present an unnecessarily large proportion, unfitted by personality and lack of education or ability, to be part of an organization engaged in work, the ultimate object of which is efficiency. Seniority is seemingly given undue weight, with too little regard for education, fitness, and usefulness to the general cause.

It seems incredible that a man can rise to the position of instrumentman without having mastered the elements of geometry, yet such can be found. Likewise in positions lower than instrumentman, men capable of moving up can be found working side by side, over long periods of time, with men whose usefulness ceases with holding the end of a tape. Too often both classes receive like recognition from those whose recognition counts and too seldom is any effort made to get rid of the undesirable men.

Nothing lowers morale more quickly than injustice and it looks like injustice to use seniority as a basis for promotion, and at the same time allow undesirable men to accumulate and block the way for capable ones.

We have heard the word "standard" often used. Railways, highway organizations, steel companies, and public service corporations all have standard construction methods, standard lettering, standard size drawings, etc. A great deal of benefit has been derived therefrom. Why are there not some standards for promotion and employment? Why could not a railroad for instance, use a result getting method of obtaining accurate information as to the education, ability, fitness and personality of the rank and file and prospective employees. If given proper weight in making promotions it seems reasonable that the money paid in salaries would be a better investment for men would work with more faith and less dissatisfaction; that is, the morale of the men in minor positions would be improved and would favorably reflect on the entire engineering profession.

ARTHUR JARVIS.

Richmond, Va.
March 28, 1924.

American and Norwegian Hydro-Electric Costs

Sir—E. G. Hopson, consulting engineer in Portland, Oregon, contributed an interesting letter in your issue of March 13, 1924, p. 462.

The cost, $7, for the first 100,000 hp. in the factory is based at a 93 per cent load factor and 25 per cent reserve machinery. The cost is based as stated by Mr. Hopson, including also grounds for factories and houses, water rights, etc.

The power plant at Aura is not the cheapest power plant in Norway, but the plant is very interesting because of its possibilities for producing over 230,000 hp. in one power station on the shore of a sea that never is icebound, in a convenient location for factories and workmen.

Sundalen in Norway, April 2, 1924. EDVARD SVANOE.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Turner Has Transit Relief Plan for N. Y. Suburbs

Proposes Subway System to Extend Suburban Lines Under City—Finance Plan Given

A proposition to relieve the congestion at the city terminals of the trunk-line railroads bringing suburban traffic into New York and incidentally to relieve the city subways of a considerable part of the rush-hour traffic, as well as save time for the commuters going to and from work, has been prepared for the Transit Commission of the State of New York by its consulting engineer, Daniel L. Turner.

Briefly, this plan calls for the construction of a transit system to take the suburban traffic from terminals to be constructed on the outskirts of the city along the lines of the trunk railroads and distribute it throughout the city by means of three new lines of subways independent of the existing ones. During rush hours the greater part of the suburban trains will be run directly into the new subways; at other times or at terminals where the passenger equipment is not suitable for the new subways, passengers will transfer directly to the regular trains of the new subway system which will be operated at regular intervals.

ROUTES PROPOSED

The three lines of the metropolitan transit system are: (1) A double-track Long Island line from terminals at Jamaica and Atlantic Ave., Brooklyn, to the Battery in lower Manhattan, under existing streets and a new street between Ninth and Tenth Ave. to 57th St., thence east across under the East River to a connection with the Long Island R.R. main line to Jamaica; (2) a Westchester-New Jersey line to serve Westchester, Connecticut and New Jersey, starting from a terminal at 149th St. in the Bronx extending down under a new street located between Second and Third Ave. to 58th St., where the line divides and one branch continues down under the new street and existing street to lower Manhattan, where it crosses under the river to Jersey City and to a terminal near West Side and Sip Ave.; the other branch goes westward across 58th St. to the new street between Ninth and Tenth Ave. and thence along the same line as the Long Island line to the Battery. This line will be four-tracked from 149th St. to 58th St. and double-tracked the remainder of the way. (3) A New Jersey line to serve New Jersey exclusively, extending from the terminal at West Side and Sip Ave. south and east along the same line as the route of the Westchester, N. J., line, under the Hudson River to the Battery, and following the same line up through the east side of Manhattan Island to 57th St., where it turns west across the island and under the Hudson River to Weehawken, thence south to its starting point. This will be a double-track line. The total route miles will be 56.8 and the estimated cost of construction $552,000,000.

The plan for financing the project calls for raising the money by eight annual assessments, spread among all the beneficiaries in proportion to the benefit they will derive from the system, namely, two states, nineteen counties, and seventeen railroads.

The system will be operated by a terminal operating company and owned by the two states jointly. The estimated cost of the equipment is $185,000,000.

Details of the proposed system will be given in a subsequent issue.

Venice Joins with Los Angeles in Sewer Outfall Plan

The city of Venice is now planning to drop litigation instituted to block construction of the north outfall sewer for the city of Los Angeles. The agreement between the two cities now being considered will provide for carrying Venice sewage through the north outfall sewer to the sewage-works at Hyperion, Venice, to pay a percentage of the cost of treatment in proportion to the amount of sewage handled.

Pelton Site on the Deschutes River In Oregon to Be Developed

The Columbia Valley Power Co. has made application to the Federal Power Commission for license to develop the Pelton site on the Deschutes River in central Oregon. The plans call for a dam 125 ft. high to develop 51,000 hp.

Upon the completion of the development at the Pelton site the company plans to proceed with the development of a larger project to be known as the Metolius dam, an arch dam 270 ft. high at which 120,000 hp. will be developed.

New York Central R.R. Expands Its Motor-Truck Service

The New York Central R.R. has established five trucking zones in New York State in addition to the service established in the electric zone at New York City last year. The new zones are in and near Syracuse, Newark (N. Y.), Rochester, Medina, and Buffalo. The maximum number of tractors, trucks and trailers is at Buffalo, where twenty-eight are in service. The company does not own these trucks but lets out its work by contract to trucking companies.

Metropolitan Traffic Conference Called for May 20

Mayors of 411 cities and towns in New Jersey, New York and Connecticut within a radius of fifty miles of New York City, and the presidents of 950 civic organizations have been invited to participate in a conference on the traffic problems of this area which is to be held at the Town Hall in New York City beginning at 10:30 a.m. on May 20. The conference will be held under the joint auspices of the Automobile Merchants Association, Bridgeport Chamber of Commerce, Bronx Board of Trade, Brooklyn Chamber of Commerce, Chamber of Commerce of the State of New York, Merchants Association of New York City, New Jersey State Chamber of Commerce, New Jersey State League of Municipalities, New York State Association, North Jersey Rapid Transit Commission, Queensboro Chamber of Commerce, Staten Island Chamber of Commerce, and the Committee on the Regional Plan of New York and Its Environs.

The call for the conference, issued by the last-named body, points out that every city in the region of New York is facing the difficult task of handling not only its own constantly increasing local traffic, but also that which flows daily to and from the larger cities in the region, particularly that which originates in or is bound toward New York City. The situation, says the invitation to mayors, calls for immediate relief of present congestion and for wise planning to prevent worse conditions in the future.

The conference will consider not only the congestion of traffic, but the traffic accident situation, traffic costs, convenience of travel within the region of New York (or lack of it), the adequacy of existing bridges, tunnels, streets, and highways, the probable future need for wider, more numerous and differently located traffic arteries, and the whole relation of traffic problems to the contemplated Regional Plan of New York and Its Environs.

Laud Mead Appointment

At a recent meeting the council of the Affiliated Technical Societies of Boston adopted a resolution commending the appointment of Dr. Elwood Mead as director of reclamation. The resolution follows:

"Believing that the public is best served by having engineers in charge of engineering operations, the council of the Affiliated Technical Societies of Boston hereby expresses its commendation of the action of President Coolidge in placing a competent engineer at the head of the United States Reclamation Service.

"Resolved that copies of this be sent to President Coolidge and to the press."

A.E.C. Urges Further Study of Muscle Shoals Bids

Would Have Joint Congressional Body Weigh Offers—Advises Report From Technical Commission

Washington Correspondence

Statements that no disposition of the Muscle Shoals properties be made until a joint congressional committee has had opportunity to study all offers, that no bid should be considered which does not conform to provisions of the Water Power Act, that there is nothing to justify a belief in immediately cheaper fertilizers from the use of existing plant, and that before definite action be taken it would be highly advisable to get an opinion from a non-partisan technical commission as to the relative merits of the pending offers, constitute the main findings of a special committee of the American Engineering Council. The report of the committee, headed by Fred R. Low, president of the American Society of Mechanical Engineers, was made April 28, in a letter sent by Governor Hartness, president of the A.E.C., to Senator Norris, chairman of the Senate Committee on Agriculture. The findings of the committee are endorsed by the administrative board of the council.

FERTILIZER PROBLEM

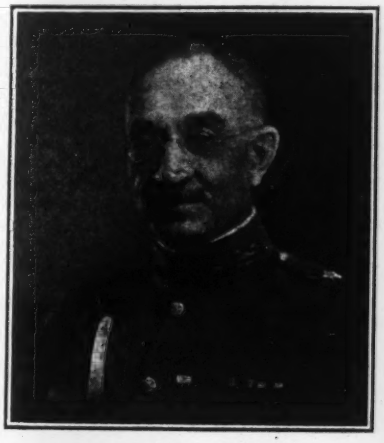
The Low committee also reported that it found nothing in the situation to justify the popular belief that operation of the Muscle Shoals plants will "make substantially cheaper fertilizers immediately available" inasmuch as nitrates constitute but one of three basic ingredients. Cheaper nitrates, therefore, would have but little effect on producing cheaper fertilizer.

In his letter to Senator Norris Governor Hartness said:

"The committee further found that recent developments of the synthetic process of nitrogen fixation had materially changed the entire outlook in the art and it is now quite possible that this process, for the use of which the so far unsuccessful Muscle Shoals Plant No. 1, was designed, may yet yield nitrate at a cost to compete with that obtained from Chile; and Plant No. 1, until recently considered a failure, may be the more valuable of the two constructed by the government for the purpose intended.

"The administrative board of the American Engineering Council has carefully reviewed the work of its committee and endorses the findings and recommendations above set forth; and in view of the great importance of the questions involved and the much apparently contradictory information thereon presented to the Congress and to the public, the said board would recommend as far as propriety permits would urge that no disposition of the plants be decided upon until a thorough investigation can be made by a disinterested technical commission, and the board hereby tenders its services to assist in the formation of such a commission if and whenever such assistance may be desired."

Named Chief of Engineers



Brig.-Gen. Harry Taylor

Taylor to Become Chief of Engineers on June 1

Colonel Jadwin to be Assistant Chief Upon Retirement of Gen. Lansing H. Beach

Washington Correspondence

Brig. Gen. Harry Taylor is to be the next Chief of Engineers of the U. S. Army. Col. Edgar Jadwin will succeed Gen. Taylor as Assistant Chief of Engineers. An announcement to the foregoing effect was made by the Secretary of War on April 23. Major General Lansing H. Beach, the present Chief of Engineers, reaches the retirement age on June 18, when he will be succeeded by Gen. Taylor.

Gen. Taylor is a native of Pilton, N. H. He was graduated from the United States Military Academy in the class of 1884. He has served with the Corps of Engineers since that date. At the outbreak of the World War, he was sent to France as chief engineer officer of the American Expeditionary Forces. Later he was assigned to special duty in the office of the Chief of Engineers, and on July 1, 1920, was appointed Assistant Chief of Engineers.

Col. Jadwin was born in Honesdale, Pa. He was graduated from the Military Academy in 1890. He commanded the 15th Engineers in France and was appointed a brigadier general in 1917. He later served as chief engineer, advance section, Line of Communications, American Expeditionary Forces; as Director of the Division of Construction and Forestry, Services of Supply, and as Director of Light Railways and Roads. In 1919 he was detailed to the American mission to Poland and served as an observer in the Ukraine. He returned to the United States at the end of 1919. His present assignment is that of district engineer at Charleston.

Replaces General Taylor

Col. Edgar Jadwin

Ford Shoals Bid Criticized by Ex-Cabinet Members

Baker Would Have Government Retain Control of Property—Garfield Sees Power Trust

Washington Correspondence

The Ford offer for Muscle Shoals was criticized by two former members of the cabinet in testimony before the Senate committee on agriculture.

Newton D. Baker, former Secretary of War, declared that in his opinion the government should retain control of the hydro-electric development, rejecting all private bids. James R. Garfield, former Secretary of the Interior, asserted that the Ford offer would create a great power trust.

FERTILIZER CONSIDERATION MINOR

Mr. Baker related the reasons which actuated the administration in launching the development at Muscle Shoals as a war need. Reverting to present offers for disposition of these projects, the former secretary advanced the opinion that the fertilizer consideration is of relatively minor importance. "If some one should invent a chemical process for producing nitrogen it would be tragic to have this greatest water-power east of the Mississippi tied up for 100 years with some uneconomic process."

The power from the Muscle Shoals dams should be distributed to make existing industries more efficient and enable them to operate at a lower cost, Mr. Baker said. He opposed giving any individual or private corporation any rights at Muscle Shoals not in conformity with the Water Power Act. He said a dozen offers such as the Hooker-White-Atterbury bid could be secured.

The rates for power developed at Muscle Shoals should be regulated and any grant there should be consistent with the Water Power Act, former Secretary Garfield declared. "The gentlemen representing Mr. Ford are not philanthropists," Mr. Garfield said. "They are trying to get for themselves the greatest possible advantage."

"It is the mere glamour of a name that has attracted people to the Ford offer," Mr. Garfield added. The former secretary differed from Mr. Baker, however, in declaring that he preferred to have some adequate private lease executed rather than to have government operation.

N. Y. Building Congress Holds Annual Meeting

Progress reports of various standing committees, an appeal from James Baird, president of the George A. Fuller Co., for greater interest on the part of contractors in the apprenticeship problem, election of officers, and report of the recent very successful membership drive, were outstanding features of the annual meeting last week of the New York Building Congress. A year ago, the conference was told, the New York Building Congress had but 400 members, as compared with the more than 1,400 now enrolled.

Among the chief building trades problems which the congress had undertaken to solve is that concerning apprentices. The congress has been responsible for a revivification of interest in evening study, a survey showing that the following trades now have the number of evening classes shown: carpenters, 22; electricians, 10; painters and decorators, 2; upholsterers, 3; drafting room apprentices and cement masons, 1 each; and sheet-metal workers, 10.

Officers elected for the ensuing year are: president, Stephen F. Voorhees; vice-presidents, A. J. Post, William O. Ludlow and Alexander Kelso; secretary, Richard A. Wolff; and treasurer, Benjamin D. Traitel.

The congress maintains twelve standing committees, as follows: apprenticeship, arbitration, building conditions, codes, elimination of waste, finance, membership, program, publicity, seasonal employment, standardization and survey.

High Water Tests System of Miami Conservancy District

Following the rainfall of March 27 and 28, the Miami Valley experienced the largest flood which has occurred since the works of the Miami Conservancy District were completed. Water was stored back of all the dams to the following depths above the conduit floors: Germantown 41.6 ft., Englewood 40.6 ft., Lockington 27 ft., Taylorsville 23 ft., Huffman 22 ft. Conduits ran full at all dams except Huffman. Maximum discharges at the dams were as follows: Germantown 6,650 sec.-ft., Englewood 8,400 sec.-ft., Lockington 5,350 sec.-ft., Taylorsville 23,000 sec.-ft., and Huffman 13,000 sec.-ft.

In the improved channels, gage heights of 12.3 and 13 ft. were reached at Dayton and Hamilton, respectively. The maximum discharge at Dayton was 36,000 sec.-ft. and at Hamilton 42,000 sec.-ft.

While the flood was small compared with the actual capacity of the system, it demonstrated the ability of the flood-control works to serve their intended purpose; in this case the gage height at Dayton would have been 5 or 6 ft. higher under conditions existing before the system was installed. Although the flood would not have caused much trouble under the old conditions it would have caused considerable alarm among the inhabitants of the low-lying sections of Dayton and Hamilton, a condition which was almost entirely eliminated this year.

Ambrose Swasey Is Awarded John Fritz Medal

On April 23, in the Engineering Societies Building, New York City, the John Fritz Gold Medal, awarded annually for signal achievement in the engineering field, was presented to Ambrose Swasey of Warner & Swasey Co., Cleveland. Mr. Swasey was awarded the prize on the basis of his achievement as a designer and manufacturer of instruments and machines of precision, a builder of great telescopes, a benefactor of education, and the founder of Engineering Foundation.

Addresses were made by Charles F. Rand, chairman of the Board of Award; Dr. William Wallace Campbell, president of the University of California and director of Lick Observatory; Gen. William Crozier, formerly chief of ordnance, U. S. Army; and Dr. John R. Freeman, past-president of the American Society of Civil Engineers and American Society of Mechanical Engineers.

The John Fritz Medal is a joint award of the American Society of Civil Engineers, American Institute of Mining & Metallurgical Engineers, American Society of Mechanical Engineers, and American Institute of Electrical Engineers.

Decline Single Newark Base Bid

Only one bid was made for the Newark Army Base at the auction held on April 28. This bid was $3,500,000 and was made by Pacific Coast interests whose identity was not revealed. The bidder tendered a certified check as a guarantee, but withdrew his bid when the government officials indicated that the offer would not be accepted. The government values the base at $10,000,000. It includes 133 acres of land fronting on the ship channel valued at $1,300,000 and buildings which cost around $12,000,000.

House Members Seek Funds for San Carlos Project

Members of the House of Representatives from the Southwest are making a determined effort to secure consideration by the House of the bill authorizing an appropriation of $5,500,000 for the continuance of construction work on the San Carlos irrigation project on the Gila River in Arizona. The bill has been passed by the Senate and has been reported favorably by the House Committee on Indian Affairs.

Storage must be provided on the Gila if the Pima Indians are to be allowed to continue to make a living from their lands. Settlement of the country above has resulted in the entire appropriation of the low-water flow of the river.

It is argued that the government is morally obligated to make this improvement since the Indians have been cultivating these lands with great success for more than 300 years. The tribe always has been friendly to the white settlers. The cost of the project would be repaid in twenty annual installments.

National Sewage-Works Body Under Consideration

At the annual meeting of the New Jersey Sewage Works Association held at Trenton, April 25, a committee was appointed to report a year hence on the advisability of changing the name of the association to the American Sewage Works Association with the idea of making the organization nation wide. It was remarked that there are already members in ten states. The committee consists of S. Fisher Miller, president of the Pacific Flush Tank Co.; H. A. Croft, chief, Bureau of Engineering, New Jersey State Department of Health, Trenton; and Myron E. Fuller, Philadelphia, treasurer of the association.

In continuation of what he has done at earlier meetings, Dr. Wilhelm Rudolphs reviewed the work during the past year at the sewage substations operated jointly by the New Jersey Agricultural Experiment Station and the State Department of Health. Because of changes in the Imhoff tanks of the Plainfield sewage-works during the year, the tanks were overworked and thus an opportunity was given to study resultant foaming. It was found that during foaming there is an enormous increase in the fauna of the tank.

A paper on settling tanks and separate sludge digestion was read by W. D. Vosbury, of Camden, who made some comparisons of one-story septic tanks, Travis Imhoff, and Kremer-Kusch tanks. Mr. Vosbury stated that sedimentation is a mechanical process, while sludge digestion is a biological process, and that in attempting to carry on the two processes in one tank conflicts arise which decrease the efficiency of both sedimentation and of digestion. Particular stress was laid by Mr. Vosbury upon the unsatisfactory way in which many sewage-works are operated.

A general description of the Philadelphia sewage-works program, which includes the eventual construction of three large sewage-works, was given by H. M. Beaumont, assistant engineer, Bureau of Surveys, Philadelphia.

Surety Bond Companies to Meet Contractors

In accordance with suggestion made by the Associated General Contractors and the American Association of State Highway Officials for a joint meeting with the surety bond houses to discuss matters of mutual interest, the Surety Association of America recently passed resolutions approving of the plan and appointing a committee of seven to represent the surety companies in such a joint conference. The committee appointed consists in representatives from the Continental Casualty Co., American Surety Co., United States Fidelity & Guaranty Co., National Surety Co., Fidelity & Deposit Co., Aetna Casualty & Surety Co. and Maryland Casualty Co. Harve G. Badgerow, representing the Continental Casualty Co., was selected as chairman of the committee.

No definite date has as yet been set for the joint conference, but it will probably be held some time during June.

Lindon Wallace Bates

Designer of Large Hydraulic Dredge Equipment—Opponent of the Lock Canal at Panama

Lindon Wallace Bates, whose death at Paris, France, on April 22 was announced in the issue of April 24, was born at Marshfield, Vt., on Nov. 19, 1858, and was educated in Central High School, Chicago, and Sheffield Scientific School at Yale.

He began work with the Chicago, Burlington and Quincy R.R. in 1877 but after a few months went to the Pacific Coast where he served as an engineer on location and construction on the Northern Pacific, Oregon Pacific, and the Oregon Railway and Navigation Co. Later he went into business as a contractor. In 1885 he became prominent through the successful reclamation of the Kaw River at Kansas City by the use of a dredge which he had redesigned. In 1888 he built the Puyallup dam on Puget Sound, one of the first ever built with a hydraulic dredge. This was followed by his work on the Chicago Drainage Canal in 1892 and his entry in 1893 into the competition for the design of a dredge for the Mississippi Commission in which he won the premium of $87,000 for the construction of the Beta, a dredge which delivered over 5,000 cu.yd. an hour.

In 1896 Mr. Bates went to Europe where he made studies for the Belgian Government for work on the Scheldt River below Antwerp, for the Russian Government on the deepening of the Volga and the ports of the Black Sea, and subsequently designed five electrically-operated dredges for the Russian Government. Two years later he went to Australia where he prepared plans for the improvement of several harbors, remaining in a consulting capacity during the execution of the plans. It was at this time that the Hercules, one of his dredges built for use in Queensland, while on its way out from England, was, at the request of the Suez Canal board, used during its passage through the canal for experimental purposes. Its operation was so successful that the board decided to enlarge the canal by similar dredges.

Subsequent to this Mr. Bates was called into consultation on dredging work in Egypt, and China, returning to the United States to undertake the work of raising the grade of the city of Galveston, and work on the New York State Barge Canal.

Mr. Bates took an active part in the discussions concerning the Panama Canal, being one of the advocates of a low-level canal.

Soon after his work on the Barge Canal was completed, Mr. Bates retired from active life only to return to it again during the war, first as vice-chairman of the Belgium Relief Commission under Herbert C. Hoover and later as chairman of the engineering committee of the Submarine Defense Association.

Smith Signs N. Y. Home-Rule Act

A municipal home rule act carrying out the provisions of the constitutional amendment adopted by the voters of New York State last November was passed by the legislature just before adjournment and on April 25 was signed by Governor Smith. It gives the municipalities of that state a considerable degree of control over their local affairs, subject to the limitations of the enabling act.

A. G. C. Executive Board to Meet

The executive and advisory board of the Associated General Contractors will meet in Cleveland May 3 at a regular session to discuss a wide range of subjects. At the same time, the president's council, composed of the 48 chapter presidents, and the chapter secretaries' council, will meet. Among the outstanding topics to be discussed at the Cleveland meeting are the proposed Department of Public Works; day labor, the proposed manufacturers' division of the A.G.C., winter operation, and the quantity survey.

Am.Soc.C.E. Announces Annual Convention Program

The fifty-fourth annual convention of the American Society of Civil Engineers will be held in Pasadena, Calif., June 18-21. The annual address by the president of the society, C. E. Grunsky, will be preceded by the opening of the convention by Franklin Thomas, president of the Los Angeles Section, and a speech by Governor F. W. Richardson of California. During the afternoon of the first day, there will be a 25-mile sight-seeing excursion by automobile to points of interest about Pasadena, among which are the Devil's Gate dam, Brookside Park, Arroyo Seco bridge, Oak Knoll and Altadena. A garden party will follow the excursion. During the same afternoon there will be a golf tournament at the Annandale Country Club and later a sight-seeing trip to Echo Mountain and Mount Lowe, thence to the Alpine Tavern for dinner.

The technical program for the morning of June 19 will be devoted to discussion of a paper on "The Colorado River Problem," to be presented by Col. William Kelly, Corps of Engineers, chief engineer of the Federal Power Commission. During the afternoon of June 19 simultaneous meetings of representatives of local sections and technical divisions will be held. An automobile excursion will take place at the close of the technical meetings. This excursion will terminate at the Thomas H. Ince studios at Culver City.

An all-day excursion will be held on June 20. This will consist principally in an inspection of the Los Angeles harbor and a visit to Santa Catalina Island. An all-day excursion to works of engineering interest has been planned also for Saturday, June 21. The principal points of interest in this excursion will be the tri-cities sewage-disposal plant, the Los Angeles outfall sewer and screening plant, and the Weid Canyon dam.

Random Lines

Engineers' Weather

"What kind of weather have you had up in Boston lately?" asked a southern client of ours. One of our resident engineers with a pessimistic turn of mind said, "Oh, we've had regular resident engineers' weather."

" 'First it blew and then it snew
Then it friz and then it thew.
Then there came a shower of rain.
Then it friz and thew again.' "

—From Lockwood, Greene & Co.'s *Engineer*.

* * *

There Are a Few New Ones

Cafeteria Engineer — A young lady with that title figures in the New York court news.

Office Equipment Engineers—A furniture house in Newburgh, N. Y.

Cash Register Engineer—A Cincinnati gentleman. The record doesn't show whether he is of the designing, constructing or operating variety.

Development Engineer — A Chicago patent attorney.

Projection Engineers—The Salt Lake Theatre Supply Co., Sam I. Levin, president.

* * *

Interchangeable Parts

"A new idea of having clothes designed in sets was introduced yesterday afternoon by Mme. Berthe Holley, who gave a fashion show at the Hotel Plaza. For many years she has been a disciple of individuality in clothes and has often been called a dress engineer because of her geometrical dress designs. She builds models by means of squares and triangles of material and by effective combinations with slips and tunics makes a few dresses serve for many."

—New York *Times*.

* * *

Elephants is Elephants

In its advertisement in the April 17 issue the H. K. Porter Co., tells very entertainly of its first locomotive built 59 years ago, which, in the absence of a toll classification to cover it, had to pay bridge toll at tariff rates for elephants. Ellis Parker Butler's "Pigs is Pigs" man must have descended from this toll collector.

* * *

He Has The Power; Why Not Give Him A Good Name?

Sir—I have discovered the correct title by which to address the janitor of an apartment house—in a recent story in the Satevepost. The italics are mine:

> "A note from him the next day announced that the arrangements had all been made and that *the keys would be delivered to her by the resident engineer*, on demand. . . . She found herself confronted by the unexpected luxuriousness of the studio apartment.

G. E. B.

Engineering Societies

Calendar

Annual Meetings

NATIONAL FIRE PROTECTION ASSOCIATION, Boston, Mass.; Annual Meeting, Atlantic City, N. J., May 13-15, 1924.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, New York City, May 19-24, 1924.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago, Ill.; Annual Meeting, San Francisco, Calif., June 11-13, 1924.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Convention, June 18-20, Pasadena, Calif.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia, Pa.; Annual Meeting, Atlantic City, N. J., June 23-28, 1924.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh; Annual Meeting, Boulder, Colo., June 25-28.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Boston, Mass., Sept. 29-Oct. 3, 1924.

The Rhode Island Highway Association's annual meeting was held at Rhode Island State College April 19. The program included addresses by G. E. Henderson of the Board of Public Roads and the state highway commissioner of New Hampshire, Frederick E. Everett.

The Wisconsin Section of the American Waterworks Association will hold its annual meeting June 12 and 13 at Eau Claire, Wis.

Personal Notes

M. EASBY, INC., constructing engineers, announce removal of their offices to the Schaff Building, 1505 Race St., Philadelphia.

HERMAN FOUGNER, recently vice-president of the Thompson-Starrett Co., has been elected vice-president and director of Thompson & Binger, Inc., engineers and contractors, New York City.

E. W. ALLEN, formerly engineer and assistant manager of the central district of the General Electric Co., with headquarters in Chicago, has been appointed manager of the engineering department of that company under Francis C. Pratt, vice-president in charge of engineering. A. F. Riggs has been appointed district engineer at Chicago to succeed Mr. Allen.

THURMAN W. DIX has been reappointed chief engineer of the Vermont Department of Highways, for the year 1924.

FREDERICK POPE and ALVA O. GREIST have become associated as consulting and designing engineers, specializing in chemical, power and public utility work. The offices of the new organization are at 280 Madison Ave., New York.

D. E. A. CAMERON, recently with the Watts & Suhrbier Co., contractors, Toledo, Ohio, on March 17 became chief engineer for the Gettins-Kopitke Co., contractors, Toledo, Ohio.

W. S. BURNETT, district engineer of the Cleveland, Cincinnati, Chicago & St. Louis Ry., has been appointed engineer of construction with headquarters at Indianapolis, Ind.

HERBERT J. FLAGG, chief engineer of the Washington State Department of Public Works for the past four years, has resigned to become assistant manager of the Grays Harbor Railway & Light Co. in Aberdeen, Wash. Mr. Flagg is an engineering graduate of the University of Washington. Following graduation in 1912 he entered private practice at McMinnville, Ore., where he became assistant city engineer. He was also city engineer for the towns of Dallas and Hillsboro, Ore. He entered the service of the state in 1915 as an assistant engineer.

J. W. CAREY, assistant chief engineer of the Washington State Department of Public Works, will succeed Herbert J. Flagg, resigned, as chief engineer of the department.

HADLEY BALDWIN, heretofore assistant to the general manager of the Cleveland, Cincinnati, Chicago & St. Louis Ry., has been appointed chief engineer with headquarters at Cincinnati, Ohio, to succeed C. A. PAQUETTE who has resigned. Mr. Baldwin was born in February, 1867, graduated from the University of Michigan in 1893 and entered the service of the Cleveland, Cincinnati, Chicago & St. Louis Ry. the same year. Since that time he has been continuously in the service of this railway company in various positions in the engineering and operating departments. Previous to his being made assistant to the general manager, he served as chief engineer of maintenance-of-way and later as assistant chief engineer.

FRANCIS C. SHENEHON, recently resigned from Byllesby Engineering & Management Corporation, has reopened his offices in Minneapolis as a consulting hydraulic engineer. He is succeeded by H. W. FULLER, an electrical engineer and vice-president in charge of operation of Northern States Power Co.

H. H. JONES, for 13 years president and general manager of the San Diego Consolidated Gas & Electric Co., has been made vice-president in charge of operation of the Northern States Power Co. Mr. Jones is a civil engineer graduate of Lehigh University. He gained his early engineering experience with steam and street railroads. He entered the employ of H. M. Byllesby in 1909, going to the San Diego position a year later.

JACOB FELD is now with the Barney-Ahlers Construction Corporation, New York City, as concrete designer on industrial structures. Until recently, Dr. Feld was with H. D. Robinson and D. B. Steinman, consulting engineers, as designer on foundations and long-span bridges.

Obituary

CHARLES E. WARREN, county superintendent of highways for Jersey County, Ill., died in a hospital at Jerseyville, Ill., on April 7. Mr. Warren, who was 43 years old, had been county highway superintendent for ten years. He was a graduate of Illinois University and prior to his county work did engineering for several railroads.

JAMES CROSGROVE, for many years identified with the firm of Booth, Ryan & Crosgrove, railway contractors, died April 23 at Prescott, Ontario, in his 90th year.

JOHN F. MEIGHAN, civil engineer and at one time city engineer of South Bend, Ind., died recently in that city, of heart disease, aged 77 years. Mr. Meighan went to Logansport, Ind., in 1872 and later was county surveyor of Carroll County. Then he spent some years in mining and irrigation engineering in Mexico. From 1888 to 1897 he was assistant city engineer at South Bend and was appointed city engineer in 1900.

THEODORE W. SNOW, president of the T. W. Snow Construction Co., Chicago, died April 20. He was born at Bloomingdale, Ill., in 1858, and began his experience in county surveying and with a survey party of the Chicago & Northwestern Ry., from 1877 to 1881. In 1885 he took charge of the new Chicago office of the Pennsylvania Steel Co., and handled the western work of the company's signal department. In 1886 he went to the U. S. Wind Engine & Pump Co., Batavia, Ill., and was in charge of the construction department for several years, averaging the design and construction of about a dozen water-works plants annually. A few years ago he organized the T. W. Snow Construction Co., to undertake the construction and equipment of railway water and coaling stations. Mr. Snow was a member of the Western Society of Engineers.

FRANK G. EWALD, chief engineer of of the Illinois Commerce Commission, died at Evanston, Ill., April 27. He was born at Winona, Minn., in October, 1862, and began his engineering experience in 1883 as a rodman on the Chicago & Evanston Ry., after which he served with several railways, including the St. Paul & Northern Pacific and the Chicago, Burlington & Northern. After a short time with the Spring Valley Coal Co. he went to the Atchison, Topeka & Santa Fe Ry. in 1887, becoming division engineer on the Chicago extension and in 1892 was made resident engineer in charge of track, bridges, buildings and water service of lines east of the Missouri River. About 1898, Mr. Ewald was made chief engineer of the Illinois Railroad and Warehouse Commission, which later became the Illinois Commerce Commission, and held this position until the time of his death. He was a member of the Western Society of Engineers and the Illinois Society of Engineers.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Construction Equipment—Past and Present

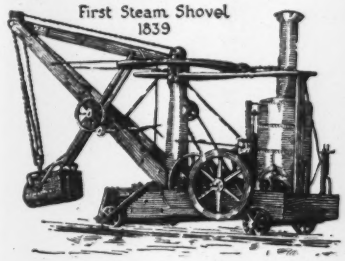
A Series of Historical Sketches of the Origin and Development of Machines for Contractors and Engineers

II—The Power Shovel

AS AN accurately descriptive title the term "steam shovel" today is a misnomer, for since Feb. 24, 1839, when William Smith Otis obtained U. S. Patent No. 1089 for his "crane excavator," the power equipment of "steam" shovels has been enlarged to include gasoline engines, electric motors, and heavy-oil engines of the Diesel type. The ancestry of the power shovel is traceable to the floating dredge, which had been employed in the United States on river, harbor and canal work before the first land machine was built.

It was not until about 1865, however, that the power shovel began to come into general use. Even then, the machine, so far as manufacture was concerned, was not on a stable production basis. Coincident with the beginning of the period of large-scale railroad construction in the United States in the early eighties, however, organizations were formed to manufacture power shovels. Among the pioneers were Bucyrus (1880), Marion (1884), Osgood and Vulcan. The Bucyrus Co. sold its first shovel in 1882 to the Toledo & Ohio Central Ry.

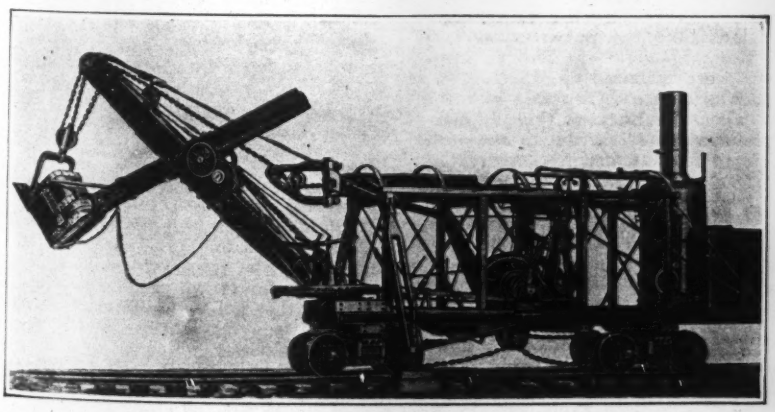
The Otis Shovel—William S. Otis was the son of a contractor, one of the early American canal and railroad builders. Otis was only 19 or 20 years old when he conceived the idea of excavating earth by steam power. His plans took definite shape in 1836 when a steam shovel was built from his designs by the firm of Eastwick & Harrison of Philadelphia. The following year this machine was used to grade several miles of the Western Massachusetts R.R. (now the Boston & Albany) running east from Springfield. At that time Otis was the junior member of the firm of Carmichael, Fairbanks & Otis, who had this contract.



The Pioneer Machine of Otis

The history of this first shovel shows that it was put to use in Maryland on a portion of the Baltimore & Ohio R.R. Like most new inventions, it required many alterations before its use could be called successful. The machine was later removed to Springfield, Mass., where it did a large amount of railroad grading. Its next destination was Brooklyn, N. Y., and from there it was taken to Canada on the "deep cut" of the Welland Canal, about 6 miles north of Niagara Falls. After finishing the widening of this cut above water, the power shovel was employed as a dredge for deepening the channel.

At the time of his invention, Otis recognized that the boilers and engines commonly used were so large and cumbersome as to be poorly adapted to the limited space that could be spared on the frame of his excavator. He therefore designed a new boiler and compact engine.



Shovel Designed by H. M. Barnhart and Built by the Marion Steam Shovel Company

When the Russian Government began the construction of the St. Petersburg-Moscow R.R. two Otis shovels were ordered for the work on the advice of Col. Whistler, chief engineer, who had witnessed the operation of the excavator at Springfield, Mass. The government of Peru bought one of the excavators about 1850 to dig guano. Otis never lived to see the complete success of his invention, as he died of typhoid fever at the age of 26.

His associate in the early days of the power shovel was O. S. Chapman who, after Otis died, entered into an arrangement with John Souther, of Boston, for the building of the shovels on a royalty basis.

Designed to operate on a 7 ft. 10-in. gage track of 8x8-in. timbers this early machine had to be dismantled completely when moved from one job to another. One 10x12-in. single, vertical engine furnished the motive power for the entire machine. A cast-iron center post or mast of hollow cross-section carried an overhead swinging circle and also the two sheaves for the hoisting chain and the sockets to which the crane boom was attached. The shipper shaft was attached to the under side of the boom and the movement of the handle was actuated by a sprocket chain connected with the top sheave in the mast. Instead of racking, the dipper stick was fitted with chains extending around a drum on the shipper shaft. The dipper capacity was 1¼ cu.yd.

First Shovel Sold by the Bucyrus Co. (1882)

One of these machines was used in filling in Back Bay, Boston. After about a thousand of these shovels had been placed on the market it was suggested to Mr. Souther that the machine be redesigned in order that it might be transported over standard-gage railroads. Mr. Souther's reply was: "If people do not want the machine I manufacture they do not have to purchase it, as I have the cream of the steam shovel business." As a commentary on this attitude, the Souther machine has long since passed completely out of existence.

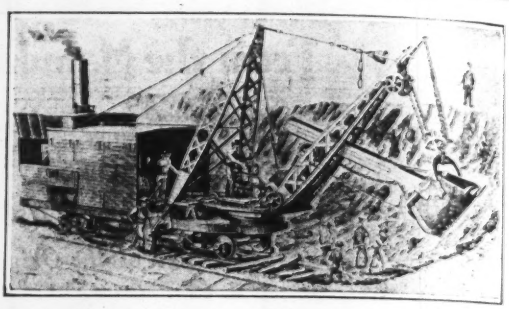
With the passing of the Otis-Souther shovel, others appeared, among them the Oswego "boom machine," designed so that it was necessary to lower the boom and raise it again with every dipper load, since the dipper handle was hinged to the underside of the

boom. While these developments were in progress the steam shovel business in the Eastern states lagged and the center of the industry shifted to Ohio. Several companies were organized to produce steam shovels. During this development two men named Wilcox and Stocks, at Toledo, built a small light shovel suitable for mounting either on truck wheels or standard-gage railway wheels. The rights of this machine, which marked a step toward mobility, were disposed of to the Vulcan Steam Shovel Co. in 1880, a competitive machine being placed on the market at the same time by the Toledo Foundry & Machine Co., known as the Victor. The latter machine was equipped with a swinging engine in place of the long steam cylinders previously used. Another shovel was manufactured for a short time by the Industrial Works of Bay City, Mich., on which the dipper handle was designed to be operated by steam through a long cylinder. The Bucyrus Co., at about this time, put on the market its Thompson shovel in sizes of 1, 1½, and 1¾ cu.yd dipper capacity; these machines were equipped with three sets of engines — hoisting, swinging, and thrusting.

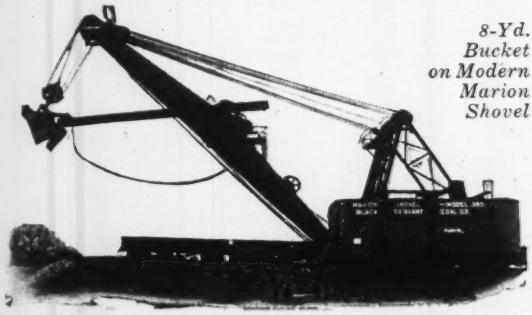
Traction Wheels on Osgood Shovel

Barnhart's Improvements — It was in 1883 that an important advance in steam shovel design was made in the machine developed by Henry M. Barnhart and Edward Huber, of Marion, Ohio. Barnhart had formerly operated a machine at Kenton, Ohio, for the Chicago & Atlantic R.R. After experiencing a great deal of trouble with the swinging gear, necessitating frequent repairs of gears and pinions, he prepared a model embodying many radical changes. He obtained a patent in the name of himself and Edward Huber and with the assistance of George W. King the Barnhart shovel was made at the Huber works in Marion, establishing the foundation for the development of the Marion Steam Shovel Co., which was incorporated in 1884. The first shovel of the Barnhart type was sold to the Cincinnati, Jackson & Mackinaw R.R. and operated in a gravel bank near Greenville, Ohio.

The early Bucyrus shovels were of two distinct types. The larger, with a 2½-yd. dipper, had what was called a crane type boom and its thrusting operations were by chain drive from the main machinery. The smaller machines, with ¾-yd. dipper, had a boom supported by a wrought-iron mast. All of these shovels had vertical steam boilers and were mounted on railroad trucks. An important development in these machines occurred in 1893 when the boom type shovel with thrusting engine was introduced. The first large-scale use of this type of shovel was on the Chicago drainage canal, in the nineties, where 27 of these shovels were operated. Up to this time the railroads had been the largest users of steam shovels and it was as the result of experience on their work that the full-circle swing principle of design was developed. One of the landmarks in power shovel history, of course, was the Panama Canal between 1904 and 1913, where about 100 American shovels were operated.



Osgood & MacNaughton's Steam Excavator (1882)



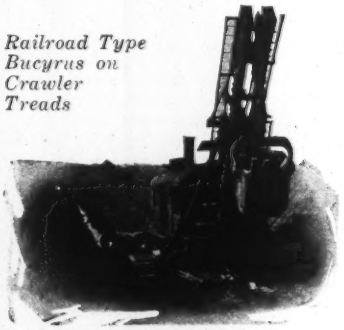
8-Yd. Bucket on Modern Marion Shovel

The Revolving Shovel—The success which attended the use of the large power shovel on railroad and canal work led manufacturers to produce a smaller revolving machine for lighter work, such as street and road grading, basement excavation, and sewer and trench work. Among the first manufacturers to open up this new field of usefulness for the power shovel was the Thew Shovel Co. The first machines were mounted on wheels and a big advance in mobility was scored in 1911 when the Bucyrus Co. adapted a continuous tread traction to one of its dragline excavators. About ten years later the same type of mounting was installed on the heavy railroad type shovels, constituting the most important improvement in the design of the power shovel made within recent years.

Prominent in the light revolving shovel field was the Erie which was introduced in 1914. For this machine was claimed far more power than had ever been obtainable in a 20-ton ¾-yd. shovel—15,000 lb. pull on the dipper combined with a better distribution of weight to balance the unequal hoisting pull. This shovel with a large lift and reach, made it possible for cont[illegible] handle cel[illegible] excavation without running wagons down into the hole to be loaded. Operation also was simplified by the introduction of a three-lever control. Continuous tread mountings were adopted to extend the usefulness and mobility of the machine.

The first power shovels were all operated by steam. The records show the equipment of a shovel with electric motors in 1911 by Bucyrus and with gasoline engines about 1914 by Thew. In the early days of the shovel as a practical construction tool during the eighties, the largest size dipper made was 2½ yd. Today what is claimed to be the world's largest shovel, a Marion, has an 8-cu.yd. dipper.

Reviewing the development of the power shovel it is seen that in addition to scores of improvements in mechanical details, the major developments included mounting on standard-gage wheels and later on crawler traction; replacement of the early crane type with the boom type of dipper handle suspension; the substitution of a swinging engine for the original long steam cylinders; introduction of three sets of engines for the operations of hoisting, swinging, and crowding; the development of the full-swing principle and the ¾-yd. revolving shovel; the enlargement of the power equipment to include electric motors, gasoline and, recently, Diesel oil engines; increase in size of dipper up to 8 cu.yd.; and adaptation of crawler or continuous tread mounting to the heavy railroad type shovel.



Railroad Type Bucyrus on Crawler Treads

An Early Model of the Erie Revolving Shovel

From the crude machines of the days of Otis, Chapman and Souther, the power shovel has been developed into a tool which is indispensable on both large and small-scale projects involving the handling of earth and rock. The power shovel has made possible the building of the great American railway systems, canals, and the operation of iron and coal mines, quarries and brick manufacturing plants. If the power shovel had never existed, Chicago might still be drawing from Lake Michigan the sewage laden water now diverted by its drainage canal and ships that pass through the Panama Canal today would still be batting around the Horn.

(Next week: The Concrete Mixer)

Paving Brick Orders Show Increase for March

That the summer season for street and highway paving is beginning to open up is evidenced by the sharp increase in shipments and orders for vitrified paving brick as shown in the regular monthly statistical report of the National Paving Brick Manufacturers Association to the United States Department of Commerce. The tonnage of the companies reporting represents 67 per cent of the total tonnage of the industry.

Unfilled orders which stood at 55,482,000 bricks on Feb. 29 had increased to 78,47,000 bricks on March 31. Due to heavy manufacture during the winter months, when shipments were light, stock on hand April 1 is still well in excess of unfilled orders, the total standing at 117,451,000 bricks.

March shipments, which are an accurate gage of the paving activity of both urban and rural sections, show an increase of more than 4,000,000 bricks, the figures being 6,442,000 for February and 10,989,000 for March.

In the Southwest Texas led in consumption with a total of 1,942,000 bricks for the month of March.

200 Tractor Operators Attend "Caterpillar" Service School

The 8-day "Caterpillar" Service School for the spring of 1924, recently held at the factory of the Holt Manufacturing Co., Peoria, Ill., drew an attendance of 200 from 14 states. The service schools as now conducted were originated by M. M. Baker, vice-president and general manager, and H. H. Chambers, director of service, of the company. They are conducted solely for the benefit of owners, users, operators and mechanics who desire to obtain firsthand and practical information with respect to the lubrication, care, adjustment and repair of the various models of caterpillar tractors.

In order to accomplish the purpose, cut-away motors, transmissions, clutches, final drive units, magnetos, carburetors, vacuum tanks, etc., have been prepared which enable the students not only to make the adjustments of the various parts, but actually to see the results of proper and improper methods. Plans are now being perfected for one or more additional schools during 1924.

Building Material Makers to Work with A.G.C.

Metal Products Manufacturers, Meeting in Cleveland April 7, Organize New Group of Affiliated Bureau

BUILDING materials, in addition to construction machinery, will be included in the program of activities of the newly organized affiliated bureau of manufacturers working in conjunction with the Associated General Contractors. This extension of the field of the bureau was endorsed at a meeting in Cleveland April 7, attended by producers of metal building products, including skylights, sash, windows, doors, trim, lath, reinforcing steel, ventilators, metal lumber and partitions. Tentative plans for organizing the new group were discussed and a resolution was passed calling for a second conference of building material manufacturers to be held at the Winton Hotel, Cleveland, May 2 and 3, when an organization will be perfected and a program of activities discussed.

Objects of New Branch

Working with the general contractors, the new manufacturers' branch of the affiliated bureau will have as its objectives the continuous functioning of the construction industry, the elimination of wasteful or unsound practices, and relief from unnecessary production and selling expense. Manufacturers of metal building products not represented at the April 7 meeting are invited to attend the conference in Cleveland May 2 and 3. Among the subjects to be considered at the forthcoming meeting are simplification and standardization of products, labor problems with regard to handling and installing building materials, contracts between manufacturers and contractors, trade practices, and selling and distributing methods.

At the April 7 meeting the foregoing plans were approved by the following representatives of manufacturers:

Guy D. Bayley, Wm. Bayley Co., Springfield, Ohio; H. F. Wardwell, R. S. Bishop, Detroit Steel Products Co.; Gustave Kahn, Truscon Steel Co., Youngstown, Ohio; H. H. Robertson, W. S. Tallman, J. L. Erwin, H. H. Robertson Co., Pittsburgh, Pa.; J. A. Schweig, Security Fire Door Co., St. Louis, Mo.; E. J. Jones, Jamestown Metal Desk Co., Jamestown, N. Y.; John A. Westman, Dahlstrom Metallic Door Co., Jamestown, N. Y.; Geo. A. Knapp, Knapp Bros. Mfg. Co., Chicago; Wm. Pfleider, David Lupton's Sons Co., Philadelphia; E. F. Hauserman, the E. F. Hauserman Co., Cleveland; R. F. Carpenter, Sannymetal Products Co., Cleveland.

Construction Equipment Exported

Figures from the Department of Commerce indicate that during February, 1924, shipments for export of excavators, including power shovels, from the United States involved 14 machines costing $101,190. The largest consignment was 9 machines to Kwangtung, a province of China, at a cost of $52,885.

Cinder Concrete Men Meet

The second annual convention of the National Cinder Concrete Products Association (Straub Licensees) was held March 7, in Philadelphia. Quality products and prices high enough to prove the quality contention were the keynotes of the convention. It was announced that the present daily capacity of Straub plants is 133,000 8x8x16-in. blocks, or one Straub cinder block for every 9½ concrete blocks made in the United States, or the wall equivalent of 1,800,000 bricks per day.

The following officers were elected: F. J. Straub, president; Henry Boettcher, first vice-president; Howard Brooke, second vice-president; J. Edwin Rutter, secretary; G. Edgar Allen, treasurer.

Trash Pump Patent Suit Settled

Litigation extending over a number of years has been brought to a close in the case of the so-called trash pump developed by A. Baldwin Wood, engineer with the Sewerage and Water Board of New Orleans, designed for handling water containing a large amount of solid matter. Recently the Federal Court at Mobile affirmed the Wood patent claims and issued a permanent injunction against the Atlantic, Gulf & Pacific Co. In the settlement of the case the Atlantic, Gulf & Pacific Co. has paid Mr. Wood $75,000. The Wood pump was designed originally to handle sewage and was later applied to dredging operations.

Trailer Manufacturers Elect New Officers

The Trailer Manufacturers Association, New York, announces that Harvey C. Fruehauf, vice-president of the Fruehauf Trailer Co., Detroit, has been chosen by its executive committee to succeed M. E. Crow as president of the association. Mr. Crow, who was active in the recent reorganization of the association, was elected president temporarily while this work was in progress with the understanding that a successor should be chosen this spring. S. E. Liedabrand of the Automotive Trailer Co., Springfield, Ill., succeeds Mr. Fruehauf as first vice-president. The other officers remain the same.

Business Notes

J. D. Adams & Co., Indianapolis, Ind., manufacturer of adjustable leaning-wheel graders, report that the portion of their manufacturing plant which was burned Feb. 1 has been entirely rebuilt and that their production is again in full swing. At the time of the fire the company had sufficient finished stock in its warehouses throughout the country to take care of the demand during the reconstruction period and now that production is back on a normal basis continued prompt shipment of all orders is assured. The rebuilt factory unit is larger than the one destroyed and with the installation of modern equipment and methods the capacity has been increased. Other

building operations in process or planned for completion this year will practically double the capacity of the entire plant as it stood before the fire. The expansion, the company announces, is to keep pace with the sales organization which was enlarged this year and the constantly increasing sales of Adams products, particularly leaning wheel graders.

TURNER CONSTRUCTION CO., New York, built 68 concrete structures for industrial and other uses during the year 1923. To indicate the extent of the company's operations, the buildings have been grouped in a single architects' drawing with a key on the reverse side indicating the location of the structure and the names of the owner, architect or engineer.

GRAVER CORPORATION, East Chicago, Ind., has removed its railroad office from the Steger Building, Chicago, to the main office and works of the company at East Chicago, Ind. The department will be in charge of J. J. Felsecker, manager of water softening sales, as W. R. Toppan, who had charge of the railroad department, left the company March 1. The office in Chicago will be maintained as a branch sales office.

LINCOLN VAN GILDER, for many years superintendent and chief engineer of the Water Department of Atlantic City, N. J., has entered the business of manufacturing water meters under the name of the Van Gilder Water Meter Co., Pleasantville, N. J., of which he is president.

BLAW-KNOX CO., Pittsburgh, manufacturer of steel forms for concrete, clamshell buckets, road forms and other steel products, announces the following changes in its sales personnel: Robert T. Harris has been transferred from New York to become district sales manager in Baltimore. Walter H. Duncan, formerly field engineer for the John F. Casey Co., contractors, has joined the sales staff of the road equipment department. William F. Glasser, formerly engineer in the heavy forms department, has been promoted to assistant chief engineer of the department. Charles K. Wehn has been transferred from Chicago to Pittsburgh as district manager of the standard steel building department. R. D. Spradling, formerly at Baltimore, has been made district manager of the standard building department at Chicago.

MARTIN TRACTOR SHOVEL CO., Greensburg, Pa., is the new name of the organization formerly called the Universal Machine & Equipment Co. The change in name was made to identify the company with its product, a power shovel operated by a Fordson tractor engine. There has been no change in personnel or management.

A. LIETZ CO., San Francisco, manufacturers of engineering instruments, had its offices and display rooms gutted by fire March 15. The factory and warehouse are located in an entirely separate building which was not damaged. Although suffering a loss of about $40,000, the company saved its books and records and is transacting business from the factory. It is expected that within 60 days the interior of the office building will be refinished and new fixtures installed so that business may be resumed.

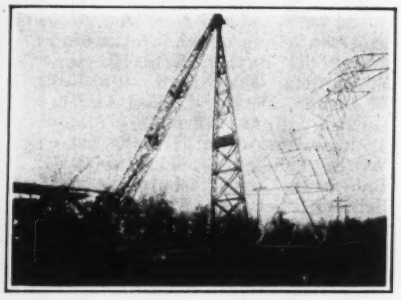
LATHROP & TROTTER have been appointed Cincinnati representatives of the Conveyors Corporation of America, Chicago, manufacturer of coal and ash-handling equipment.

WESTINGHOUSE ELECTRIC AND MANUFACTURING CO. is enlarging its plant at Sharon, Pa., by a group of fireproof reinforced-concrete-and-steel buildings which will afford an additional floor space of about 6 acres and will be devoted chiefly to the manufacture of transformers with a capacity greater than 500 kva. The present works cover 7 acres and are devoted entirely to the manufacture of transformers with a capacity of 500 kva. and less. The new additions will now allow the company to carry out its long contemplated expansion in the transformer field. With the exception of the steel frame work which is being erected by the American Bridge Co., Stone & Webster, Inc., have charge of the building according to the plans and specifications and under the general supervision of Bernard H. Prack, architect and engineer. The new buildings will be ready for occupancy about Nov. 1.

Equipment and Materials

Crawler Crane Adapted to Steel Tower Erection

A new machine for the erection of high-tension steel towers, which are built up lying horizontally on the ground and then raised into position,



has been devised by the Northwest Engineering Co., Chicago, builders of crawler cranes, shovels and draglines. It is an adaptation of the crawler crane in which a 50-ft. boom with a shear-leg is substituted for the usual 40-ft. boom. This shear-leg is equipped with telescopic legs to compensate for the unevenness of the ground and with ball and socket joints at the top to take up strains.

A hold cable runs from one drum over the A-frame to the bottom of the shear-leg and is used to fold the shear-leg against the boom where an automatic catch holds it for traveling from tower to tower. A fall block and tackle is used with the crane. The hoisting cable is made fast to the top of the tower and the machine pulls it into position.

This machine has been used by the Public Service Co. of Northern Illinois for the erection of 90 ft. transmission towers. On this work 288 towers were erected in 75 working days. However, many unforeseen obstacles were encountered and on future work it is expected that the daily average will be ten towers a day.

By replacing the tower-hoisting boom the machine is convertible into a standard crane or shovel.

Ditcher Specifications Severe

Severe specifications have been written for a railroad ditcher ordered from the American Hoist & Derrick Co., St. Paul, by the Uintah Railway Co., Mack, Colorado. The ditcher, which is to be delivered May 15, according to information received from Foster G. Morss, division engineer for the railway, will be mounted on its own self-propelled truck and must be capable of handling one dump car, in addition to itself, on 7½-per cent grade and 82-degree curves with a 3-ft. track gage. Mr. Morss points out that "these are unusually severe specifications."

New Localized Treatment With Creosote Saves Waste

By a new process which localizes the application of creosote to lumber, making it possible to treat only those portions of a pile or pole subject to decay, the American Creosoting Co., New York, claims that substantial savings may be made in the amount of oil used. The apparatus, invented by W. C. Zeller, consists of a retort in the form of a long horizontal cylinder fitted at its top and bottom with perforated pipe through which a mixture of air and preservative is injected and withdrawn. By means of valves it is possible to control the flow of the mixture through any portion of the retort desired so that treatment may be confined to a particular section of the lumber within the container.

In other words, it is possible to produce localized impregnation even though the entire length of the pile or pole is within the retort. The equipment, it is claimed, permits piles, poles, and other long timbers to be given a localized pressure impregnating treatment while the timbers are in a substantially horizontal position, a fact which leads to important economies over methods or an apparatus for impregnating which require that the timbers shall be located in a substantially vertical position while impregnation is taking place.

Publications from the Construction Industry

Resurfacing with Asphalt — TEXAS CO., New York, describes in a 5-p. illustrated pamphlet methods of resurfacing worn brick and block pavements with asphalt. Photographs and cross-sections supplement the descriptive text.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Value of April Contracts Twelve Per Cent Under Year Ago

Fourteen Per Cent Below April, 1923, in Actual Physical Volume—Gains in South, Middle West, Far West and Canada

Contracts awarded on large engineering construction projects during April totaled $174,915,000 as against $170,313,000 during the preceding month. Compared with a year ago April, 1924 construction shows a drop of 12 per cent in money value and 14 per cent in actual physical volume.

Minimum costs observed in the Construction News section of *Engineering News-Record*, on each class of construction are as follows: Water-works and excavations, $15,000; other public works, $25,000; industrial construction, $40,000 and commercial buildings, $150,000.

Construction was more active during April than for the month preceding in the South, the Middle West, the Far West and Canada and fell off slightly in New England, the Middle Atlantic States and the states immediately west of the Mississippi. April contracts, however, showed a decided falling off in sewers, commercial buildings and Federal Government work.

The actual physical volume of construction represented by April contracts is 9 per cent under the corresponding period in 1922; 59 per cent above April, 1921 and 20 per cent greater than the same month in 1920.

Among the large projects awarded during April were the following: A hospital, Cleveland, Ohio., $3,225,000; improvements on the Southern Ry system at Caswells, Tenn., $3,000,000; a bridge, Portland, Ore., $2,820,000; a grain elevator, Vancouver, B. C., $2,500,000; a hospital, Chicago, Ill., $2,500,000; bank and office building, Buffalo, N. Y., $2,000,000.

Engineering News-Record Construction Cost Index Number

May, 1924	222.38
April, 1924	221.60
May, 1923	216.70
Peak, June, 1920	273.80
1913	100.00

Jan., 1923	191.70	Aug.	221.50
Feb.	197.40	Sept.	221.50
Mar.	205.25	Oct.	220.30
Apr.	213.50	Nov.	220.90
May	216.70	Dec.	217.30
June	220.70	Jan., 1924	217.90
July	222.10	Feb.	220.30
		Mar.	224.70

Engineering News-Record's Construction Cost Index Number advanced 0.78 points since last month, owing to higher labor cost. The average rate for common labor is 56c. per hr., against 55c. one month ago and 51c. in May, 1923. Thus, general construction cost is 3 per cent higher than one year ago and 18 per cent under the peak; it is 122 per cent above the 1913 level.

Engineering News-Record Construction Volume Index Number

Monthly

April, 1924 (*4 issues of E. N.-R.*)	137
March, 1924 (*4 issues of E. N.-R.*)	134
April, 1923 (*4 issues of E. N.-R.*)	160

Yearly

1923 (entire year)	135
1922 (entire year)	130
1921 (entire year)	88
1920 (entire year)	91
1919 (entire year)	91
1918 (entire year)	80
1917 (entire year)	64
1913 (entire year)	100

Engineering News-Record's Construction Volume Index Number is 137 for the month of April, and 135 for the whole of 1923, as against 100 for 1913. This means that the actual volume of construction in 1923 (not the mere money-value of the contracts let that year) is 35 per cent above the volume of construction for 1913. Our monthly volume number, 137 for April, 1924, contains the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards.

VALUE OF CONTRACTS LET IN THE UNITED STATES AND CANADA, APRIL, 1924

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Western	United States	Canada	Total
Waterworks	.....	$831,000	$452,000	$732,000	$3,946,000	$1,506,000	$7,467,000	.....	$7,467,000
Sewers	.....	473,000	102,000	1,112,000	413,000	247,000	2,347,000	$113,000	2,460,000
Bridges	$1,035,000	75,000	1,389,000	1,613,000	1,198,000	5,363,000	10,673,000	.....	10,673,000
Excavation, drainage, irrigation	.....	379,000	237,000	8,000	409,000	1,698,000	2,731,000	.....	2,731,000
Streets and roads	1,242,000	12,203,000	7,787,000	10,890,000	6,730,000	4,290,000	43,142,000	371,000	43,513,000
Industrial works	1,295,000	3,160,000	2,470,000	2,870,000	1,250,000	1,143,000	12,188,000	923,000	13,111,000
Buildings	2,180,000	26,875,000	3,088,000	23,093,000	9,323,000	8,147,000	72,706,000	2,110,000	74,816,000
Federal government	17,000	650,000	1,269,000	133,000	113,000	464,000	2,646,000	.....	2,646,000
Unclassified	.....	1,557,000	3,820,000	50,000	1,122,000	3,120,000	9,669,000	7,829,000	17,498,000
Total	$5,769,000	$46,203,000	$20,614,000	$40,501,000	$24,504,000	$25,978,000	$163,569,000	$11,346,000	$174,915,000

Labor Rates and Conditions Throughout the Country

There is little unemployment throughout the country according to the U. S. Department of Labor's latest survey of industrial conditions. In New York, New Jersey, Pennsylvania, Illinois and other important manufacturing states employment of labor has been stimulated by the recent high rate of production in steel, machinery and allied industries. Some slackness, however, is reported in New England. Large increases in employment were reported in the following basic industries: Brick, tile, glass, iron, steel and stone.

The present construction situation is marked by a general absence of serious labor troubles. While the price trend of materials is downward there is a rising tendency in wages and employment of building trades mechanics.

The average rate paid common laborers (pick and shovel men) in construction operations in 56c. per hr. for the entire country. The rate was 55c. last month and 54c. from July, 1923 to March, 1924. Local conditions as reported to *Engineering News-Record* follow:

Boston — Building trades mechanics plentiful; not much unemployment.

CURRENT BUILDING TRADES WAGE RATES PER HOUR

(Higher rates indicated by +, decreases by —)

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$1.12½	$0.70	$0.70	$0.50	.....	$0.75	$0.25@.30
Baltimore	+1.75	+.90@1.20	1.00@1.12½	1.00	$0.65	1.12½	.40
Birmingham	1.00	1.00	.50@1.00	.30@.40	.....	1.00	.30@.40
Boston	1.25	1.00@1.10	1.25@1.35	.82½	1.05	1.12½	.60@.75
Cincinnati	1.50	1.15	1.15	.90	1.15	1.15	.52½
Chicago	1.25	1.15	1.00@1.25	.88¾	1.10	1.25	.82½
Cleveland	1.50	1.25	1.25	.87½	1.00	1.37½	.87½
Dallas	1.50	1.00	1.00	.40@.75	.87½	1.00	.30@.50
Denver	1.62½	1.12½	1.12½@1.18¾	.75@.81¼	1.00	1.15⅝	.35@.55
Detroit	+1.50	+.90@1.00	+.85@1.00	+.90	.85@1.00	+1.12½	+.60@.75
Kansas City	1.37½	1.12½	1.00@1.25	+.90	1.00	1.15	.40@.70
Los Angeles	1.25	.100	1.00	.62½	.....	1.00	.50
Minneapolis	1.12½	.87½	.87½	.71½	.....	.87½	.50@.55
Montreal	+1.00	.65	+.62½	+.45	.50	.65	+.30
New Orleans	1.25	.90	1.00	.65	.80	1.00	.35@.40
New York	1.50	1.31¼	1.50	1.00	1.00	1.31¼	.62½@.75
Philadelphia	1.50	1.12½	1.02½@1.13½	.70@1.00	1.00	1.10@1.12½	.45@.50
Pittsburgh	1.40	+1.37½	+1.25	1.00	.....	1.25	.70
St. Louis	1.75	1.50@1.60	1.50@1.67½	1.15@1.25	1.25	1.50	.45@1.10
San Francisco	1.25	1.00	1.00	.81¼	1.00	1.12½	.50@.55
Seattle	1.25	1.00	1.00@1.12½	.93¾	1.00@1.12½	1.12½	.62½

Dallas—Slight surplus of labor due to rainy spring which has held up highway construction to a large extent.

Denver—Number of employed shows substantial increase over last month.

Detroit—Decrease in employment of less than one per cent compared with month ago. No shortage in any trades; supply and demand normal.

Los Angeles—Surplus of carpenters. In other trades supply about equal to demand. Open shop conditions prevail.

Minneapolis—Trifle slow in building trades; men plentiful.

Montreal—Ample supply of mechanics. Recent advance in wage schedule.

New Orleans—Plenty of building labor; shortage of farm help.

New York—Tight closed shop conditions prevail in building industry, but with absolute harmony existing between mechanics and employers. Usual scarcity of bricklayers and plasterers feared during next sixty days. It is reported that structural ironworkers will request $1.50 per hr., against the present rate of $1.31¼.

Pittsburgh—Carpenters strike settled with wage advance of 17½c. per hr. Wage dispute now on between hoisting engineers and employers.

St. Louis—Building laborers, after month's strike, have returned to work at 7½c. per hr. increase; original demand was for 20c. Composition roofers, painters and paperhangers are the only crafts at present involved in wage disputes.

San Francisco—Small amount of unemployment in the building trades. The Industrial Association of San Francisco has granted courses in the various building crafts to over 1,200 apprentices.

Monthly Prices of Construction Materials

Ups and Downs of the Market

Pig Iron—There is no large tonnage buying of iron in the current market. Present consumption, however, is in excess of production and large reserve stocks are gradually disappearing. This surplus iron has prevented prices from rising. No. 2 foundry Southern is now 50c. below a month ago and $4@$5 per ton under May 1, 1923.

Railway Supplies—Maximum on light rails, $40 per ton, against $43 and on standard spikes, $3, compared with $3.15 per 100 lb. one month ago. Railroad material and building structurals form bulk of current steel buying.

Pipe—Pipe discount lists continue firm. Little or no change in Birmingham base, on c.-i. pipe; San Francisco warehouses up 60c. per ton on 4-in. Clay drain tile higher in Dallas; sewer pipe advanced in Boston, New Orleans, Los Angeles and Baltimore.

Road and Paving Materials—The few changes occurring in asphalt prices are of a downward nature; no fluctuations in road oils. Advances balance declines in paving stone and wood blocks.

Sand Gravel and Crushed Stone—Gravel prices advanced in Cincinnati, New Orleans and Philadelphia and declined in New York, during month. Sand quotations, however, show little change. Crushed stone higher in Cincinnati and St. Louis.

Lime—Hydrated finishing, rose 60c. in San Francisco and $4 per ton in St. Louis; a decline of 50c. is reported in Boston. Common lump, advanced $1 per ton in St. Louis since April 3. Lump finishing, dropped 10c. per bbl. in Boston. Common lump, advanced 10c. per bbl. in Boston; $1 per ton in Montreal and declined 5c. per bbl. in New Orleans.

Cement—Price advanced 5c. per bbl. at Toledo, April 15, owing to change in freight rate. Rise of 10c. per bbl. occurred in St. Louis and a drop of 2c. in Boston since April 3. In twenty out of thirty cities reporting regularly to *Engineering News-Record*, present prices are below those in effect May 1, 1923.

Steel—Prices continue to show downward tendencies. Quotations on shapes range from $2.25 to $2.50 per 100 lb. at mill; plates, $2.20 to $2.50 and bars, $2.25 to $2.40. Current buying is mostly for prompt delivery; consumers stocks show need of replenishment; production is 15 per cent below March.

Brick and Hollow Tile—General trend in brick prices upward. Boston, Minneapolis and Dallas advanced quotations 50c. per m. during month; New Orleans reports rise of 75c. Substantial increases also occurred in Baltimore. Hollow tile declined in New York since April 3, advances, however, are reported on smaller sizes in New Orleans and Montreal.

Lumber—Production, shipments and orders increasing; pine prices, however, show downward trend throughout the entire country. Slight advance in hemlock reported in Baltimore and a rather sharp rise in fir timbers in Denver during month. Better demand for common grades in pine boards, flooring and roofers.

Explosives—Few price fluctuations; advances balance declines.

Scrap—Declines in iron and steel reflected in lower scrap prices. Condition believed to be temporary as reserve iron stocks are low.

Linseed Oil—Prices firm at present levels. Aside from slight fluctuations in South and West, current quotations are below year ago.

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton—Quotations compiled by The Matthew Addy Co.:

	May 1	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	$25.05	$31.55
Northern Basic	24.00	32.27
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	24.00	33.27
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 @ 2.75)	28.00	34.44
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	*22@23*	27.00
PHILADELPHIA		
Eastern Pa., No. 2X (2.25@2.75 sil.)	24.25	32.64
Virginia No. 2 (silicon 2.25 @ 2.75)	28.17	34.17
Basic	24.00	31.50
Gray Forge	24.00	31.50
CHICAGO		
No. 2 Foundry Local (silicon 1.75 @ 2.25)	24.50	33.00
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	27.00	33.01
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	25.77	32.00
Basic	25.77	31.00
Bessemer	26.77	31.00

SCRAP—The prices following are per gross ton paid to dealers and producers f.o.b. New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	*$14.00*	$11.50	16@16.50
Stove plate	*10.00*	12.00	16.00
No. 1 machinery cast	*14.00*	16.50	19.50@20
Machine shop turnings	*8.00*	4.00	12.50@13.50
Cast borings	*9.00*	5.50	14.00
Railroad malleable	*13.00*	12.50	21.00
Re-rolling rails	14.00	13.00	21.50@22
Re-laying rails	.....	30.00	28.00@31
Heavy melting steel	*12.00*	.....	.....

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh				
	May 1	One Year Ago	Birmingham	Chicago	St. Louis
Standard bessemer rails	$43.00	$43.00	.....	$43.00	$46.00
Standard openhearth rails	43.00	43.00	$43.00	43.00	46.00
Light rails, 8 to 10 lb.	40.00	45.00	2.00*	43.00	2.55*
Light rails, 12 to 14 lb.	40.00	45.00	2.00*	43.00	2.45*
Light rails, 25 to 45 lb.	40.00	45.00	2.00*	43.00	2.35*
Rerolled Rails	*37@38*	45.00	.....	.....	2.10*

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8½ Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, White Oak	$1.70	$1.90
Chicago, Hardwood and Red Oak	1.35@1.45	1.50@1.70
Chicago....Empty Cell Creosoting (add'l)	.50	.60
San Francisco..... Green Douglas Fir	.84	1.14
San Francisco, Empty Cell Creosoted, Douglas Fir	1.70	2.25
St. Louis, White Oak	1.30	1.60
St. Louis (creosoted) (zinc treated)	1.70	2.05
St. Louis, Red Oak, plain	1.20	1.50
St. Louis, Sap pine-cypress	1.05	1.35

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh				San Francisco	Birmingham
	May 1	One Year Ago	Chicago	St. Louis		
Standard spikes, ⅝-in. and larger	$3.00	$3.15	$3.00	$3.85	**$4.85**	$3.72
Track bolts	4.00@4.25	4.00@4.50	4.00	3.90	*5.85*	4.57
Standard section angle bars	2.75	2.75	2.75	3.45	4.00	3.20

PIPE

WROUGHT PIPE—The following mill discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

BUTT WELD

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
1 to 3	62	50½	1 to 1½	30	13

LAP WELD

2	55	43½	2	23	7
2½ to 6	59	47½	2½	26	11
7 and 8	56	43½	3 to 6	28	13
9 and 10	54	41½	7 to 12	26	11
11 and 12	53	40½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	60	49½	1 to 1½	30	14
2 to 3	61	50½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	53	42½	2	23	9
2½ to 4	57	46½	2½ to 4	29	15
4½ to 6	56	45½	4½ to 6	28	14
7 and 8	52	39½	7 and 8	21	7
9 and 10	45	32½	9 to 12	16	2
11 and 12	44	31½			

WROUGHT PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	Black		
	New York	Chicago	St. Louis
1 to 3 in. butt welded	48%	50%	49%
2½ to 6 in. lap welded	44%	47%	46%
	Galvanized		
	New York	Chicago	St. Louis
1 to 3 in. butt welded	34%	37%	36%
2½ to 6 in. lap welded	30%	34%	33%

Malleable fittings, Classes B and C, banded, from New York stock sell at list plus 4%, less 5%; class A, plus 23%. Cast iron, standard sizes, 34@5% off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	Birmingham Mill	Pittsburgh	New York	
			May 1	One Year Ago
4 in.	$52@**53**	$66@68	$66.60@68.60	$63.00
6 in. and over	48@**49**	61.60@63.60	61.60@63.60	58.50

	Chicago	St. Louis	San Francisco
4 in.	$60.20@64.20	$59.60	**$64.60**
6 in. and over	57.20@60.20	54.60	60.00

Gas pipe and Class "A," $5 per ton extra.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

	New York					
Size, In.	May 1	One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$45.00	$45.00	$50.00	$62.50	.....	$73.00
4	55.00	55.00	50.00	75.00	$76.50	**83.00**
5	80.00	80.00	.....	100.00	97.75	**108.00**
6	105.00	105.00	85.00	175.00	127.50	**133.00**
8	170.00	170.00	195.00	187.50	212.50	**199.00**

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	.....	$0.105	.....	.....	$0.15	$0.12	.....
4	.....	.105	$0.11	$0.1175	.15	.15	$0.15
5	.....	.1575	.1375	.....	.23	.18	.18
6	$0.24	.1575	.165	.1645	.23	.21	.21
8	.38	.245	.26	.26	.35	.30	.325
10	.57	.3675	.338	.364	.53	.42	.476
12	.72	.4725	.442	.468	.68	.54	.612
15	1.13†	.63	.65	.78†	.90	.90	**1.02**
18	1.65†	.875	.85	1.092†	1.25	1.32	1.153
20	1.98†	1.05	1.125	.....	1.50	.....	.....
22	2.64†	1.40	1.375	1.456†	2.00	.....	1.564
24	2.97†	1.575	1.625	1.872†	2.25	2.16	2.04
27	4.81†	2.795	....	2.95†	4.69†	3.00	3.34
30	5.33†	3.096	....	3.65†	5.94†	3.60	4.06
33	6.93†	4.14	....	4.45†	6.88†	.....	4.99
36	7.91†	4.715	....	4.80†	7.50†	.....	5.42

	3	5	8	12	24	36
Boston	**$0.132**	**$0.213**	**$0.326**	**$0.64**	**$2.10†**	**$6.20†**
Minneapolis	.....	.....	.40	.72	2.55†	5.66†
Denver	.135*	.18*	.27	.47	1.70	.....
Seattle	.13	.....	.36	.72†	2.60†	.....
Los Angeles	**.16**	**.195**	.275	.475	1.65	.....
New Orleans	**.143***	**.207***	**.345**	**.586**	1.182	.....
Cincinnati	.111	.1665	.259	.4995	1.665	4.92
Atlanta	.11*	.135*	.225	.3825	1.4625	.....
Montreal	.68‡	.45†	.70	1.35	4.50†	.....
Detroit	.108	.162	.252	.486	2.205†	5.8425†
Baltimore	.117	.175	.273	.5265	1.755	**5.125**
Kansas City, Mo.	.15*	.21*	.33	.60	.....	.....
Philadelphia	.12	.18	.28	.54	1.80	5.2275

*4-in., 6-in., 9-in., respectively. †Double Strength. ‡3-in. special.

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. place named:

		May 1	One Year Ago
New York, 45% asphalt	(at terminal)	$0.053	$0.0525
New York, 65% asphalt	(at terminal)	.051	.0525
New York, binder	(at terminal)	.06	.06
New York, flux	(at terminal)	.04	.0575
New York, liquid asphalt	(at terminal)	.048	.06
St. Louis, 40@50% asphalt		.048	.055
St. Louis, 50@60% asphalt		.049	.06
Chicago, 40–50% asphalt		.0525	.0525
Chicago, 60–70% asphalt		.055	.055
Dallas, 45% asphalt		.0495	.04
Dallas, 55% asphalt		.0455	.048
Dallas, binder		.061	.053
San Francisco, binder, per ton		9.50*	9.50*

* F.o.b. Oelum, Cal. Freight to San Francisco, 80c. per ton.

ASPHALT—Price per ton in packages (350-lb. bbls. or 425-lb. drums) and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
New York (*Standard refined Mexican*)	$19@20*	$15@16
Boston (*Mexican*)	21.50	16.50
Chicago (*Stanolind*)	21.00	15.00
San Francisco, *f.o.b. refinery*, Oleum, Cal.	17.00	11.00
Dallas (*Texas*)	27.10	21.10
Seattle, "*D*" *grade, California, f.o.b. Richmond*	24.75	20.50
Denver (*California*)	24.00	
Minneapolis *f.o.b. Twin Cities* (*Stanolind*)	25.10	19.10
St. Louis (*Trinidad*)	32.50	28.50
Baltimore (*Standard Oil*)	18.00	14.00
Montreal (*Imperial*)	28.00	21.00
Atlanta (*Mexican*)	**32.00**	**28.50**
Detroit (*Mexican*)	*20.58*	*16.95*
Cincinnati (*Kentucky Rock*)		11.64
Maurer, N. J. (*Bermudez*)	28.00	26.00
Maurer, N. J. (*Mexican*)	20.50	17.50
Philadelphia (*Mexican*)	20.00	17.00
Kansas City (*Texas*)	27.30	22.30
Los Angeles "*D*" *grade, California, f.o.b. El Segundo Refinery*	17.00	11.00

*In drums.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums; 200 to 300 gal. to the ton.

PAVING STONE—

New York (grade 1)	5-in. granite, 30 blocks per sq.yd.	$140.00 per M.
Chicago	About 4x8x4 dressed	3.60 per sq.yd.
	About 4x8x4 common	2.95 per sq.yd.
San Francisco	Basalt block 4x7x8	70.00 per M.
Boston	5-in. granite, 28 blocks per sq.yd.	**135.00** per M.
Atlanta	Granite	2.66 per sq.yd.
Detroit	5-in. Granite	3.00 per sq.yd.
Baltimore	Granite	2.85 per sq.yd.
Montreal	Granite	104.75 per M.
New Orleans	Granite, 4 x 8 x 4	3.25 per sq.yd.
Cincinnati	Granite	*137.00* per M.
St. Louis	4x8x4 dressed	1.75 per sq.yd.
	4x8x4 common	1.75 per sq.yd.
Kansas City	Granite	3.85 per sq.yd.
Philadelphia	Granite	3.90@4.25 per sq.yd
Minneapolis	Sandstone	2.74 per sq.yd.

FLAGGING—

New York	Bronx, 4 ft wide	$0.22 per sq.ft.
	Manhattan, 4 ft. wide	.22 per sq.ft.
	Queens, 5 ft. wide	.24 per sq.ft.
	6x24-in. cross-walk	1.10 per lin.ft.
Chicago	18 in. wide....No market	.... per lin.ft.

CURBING—*New York*: Bluestone per lin.ft., f.o.b. barge New York, 5 x 16 in., 85c.; 5 x 20 in., Queens, 95c. *St. Louis*: Class "A" straight, delivered, 5 x 16 in., **$1.10** per lin.ft.

WOOD BLOCK PAVING—	Size of Block	Treatment	Per Sq.Yd.
New York (*delivered*)	3	16	$2.29
New York (*delivered*)	3½	16	2.56
Boston	3½	18	**2.70**
Chicago	4	16	3.20
Chicago	3½	16	2.90
St. Louis	3½	16	2.50
St. Louis	4	16	2.80
Seattle	4	16	Off market
Minneapolis	3½	16	2.75
Atlanta	3½	16	2.00
New Orleans	3	16	*1.70*
New Orleans	3½	16	*2.10*
New Orleans	4	16	*2.50*
Dallas	4	18	3.90
Baltimore	3½	16	one used
Montreal	4	16	4.50
Detroit	3	16	2.84
Detroit	4	16	3.00
Cincinnati	3½	16	2.38
Kansas City	4	16	3.00
Philadelphia	4	16	None used

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots to contractor is as follows, per cu.yd.:

	Gravel 1½ In. May 1	Gravel 1½ In. One Year Ago	Gravel ¾ In. May 1	Gravel ¾ In. One Year Ago	Sand May 1	Sand One Year Ago
New York (*alongside dock*)	*$1.75*	$2.25	*$1.75*	$2.25	$1.25	$1.25
Denver	1.90	1.90	1.90	1.90	1.00	1.00
Chicago	2.00	2.00	2.00	2.00	2.00	2.00
St. Louis	1.45	2.35†	1.45	2.45†	1.20	2.10†
Seattle	1.50	1.25	1.50	1.25	1.50	1.25
Dallas	2.38	2.25	2.38	2.25	2.00	1.90
Minneapolis	1.85*	1.75*	1.85*	1.75*	1.25-1.50	1.00
Cincinnati	**1.40**†	1.50†	**1.40**†	1.50†	**1.35**	1.25†
San Francisco	2.15	2.15	2.15	2.15	1.50	1.50
Boston	1.35†	1.50†	1.35†	1.50†	1.05†	1.20†
New Orleans	**3.00**	2.85	**3.00**	2.85	1.25	1.25
Los Angeles	2.15	....	2.20	....	1.70	1.10†
Atlanta	2.00†	1.90†	2.00†	1.90†	1.40†	1.24†
Detroit	2.05	2.25	1.75	2.25	1.35	2.00
Baltimore	1.40	1.86	1.60	2.06	0.70†	0.80†
Montreal	1.25†	1.25†	1.50†	1.50†	1.25†	1.25†
Birmingham (Crushed slag used instead of gravel)					1.14†	1.45†
Philadelphia	**2.10**	1.85	**2.10**	1.95	1.50	1.90
Kansas City		1.60		1.60	0.66*	0.66*

New York—Grits, $1.75 per cu. yd.; ready mixed, $2.00

Los Angeles—Freight from quarry, 70c. per ton, and is included in above price.

* At pit.

† Per ton.

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

	1½ In. May 1	1½ In. One Year Ago	¾ In. May 1	¾ In. One Year Ago
New York	$1.75	$1.65	$1.85	$1.75
Chicago	2.00	2.00	2.00	2.00
St. Louis	**2.20**	2.10	**2.15**	2.30
Dallas	2.83	2.50	2.83	2.50
San Francisco	2.15	2.15	2.15	2.15
Boston	1.45*	1.75*	*1.45**	1.75*
Minneapolis	1.85	2.00	2.00	2.25
Kansas City	1.50	1.50	1.50	1.50
Denver	3.50	3.50	3.50	3.50
Seattle	3.00	3.00	3.00	3.00
Atlanta	2.00*	2.00*	2.00*	2.00*
Cincinnati	**1.90***	1.75*	**1.90***	2.25*
Los Angeles *delivered*	3.00	1.60	3.10	1.60
Detroit	1.75	1.60@1.90*	1.75	1.60@1.90*
Baltimore	2.50	2.50	2.55	2.55
Montreal	1.80*	1.80*	1.90*	1.90*
Philadelphia	**2.10**	1.80*	2.10	1.65*
Pittsburgh	2.85	2.85	2.85	2.85
Cleveland	3.25*	3.25*	3.25*	3.25*

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1.30	$1.40	$2.00	$1.30
Steubenville District	1.40	1.40	2.00	1.40
Ironton District	1.40	1.40	2.00	1.40
Easton, Catasauqua, Pa.	0.85	0.90	2.50	
Birmingham, Ala.	1.05	1.15	2.05	0.80
Buffalo, N. Y., and Erie, Pa.	1.25	1.25	2.25	1.25
Cleveland, Ohio	1.45	1.45	1.45	1.25
Eastern Pa. and Northern N. J.	1.20	1.20	2.50	1.20
Western Pennsylvania	1.25	1.25	2.00	1.25
Longdale and Glen Wilton, Va.	1.25	1.25	2.50	1.00
Toledo, Ohio	1.50	1.50	1.50	1.50

LIME—Warehouse prices:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per Barrel Finishing	Lump, per Barrel Common
New York	$18.20	$13.10	$3.75*	$3.00@3.25*
Chicago	20.00	20.00	1.50†	1.50†
St. Louis	**24.00**	**20.00**	18.75‡	18.75‡
Boston	*20.00*	15.00	*3.90**	**3.10***
Dallas	20.00	....	....	1.85†
Cincinnati	16.80	14.30	....	13.40‡
San Francisco	**22.60**	....	....	2.10†
Minneapolis	25.50	21.00 (white)	1.70†	1.40†
Denver	24.00	....	....	2.70†
Detroit	22.00	20.00	....	20.00‡
Seattle, *paper sacks*	24.00	....	2.80†	....
Los Angeles	....	18.50	....	2.00†
Baltimore	24.25	17.85	2.55	....
Montreal	....	21.00	....	**10.50‡**
Atlanta	22.50	14.00	2.25†	1.65†
New Orleans	....	....	2.40†	1.80†
Philadelphia	23.00	16.00	1.93*	1.24†
Kansas City	18.40	18.40	3.92*	2.57*
Birmingham	14.50	13.75	2.00†	1.80†

*Per 280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton—Refund of 10c. per bbl. Minneapolis quotes brown common lump lime; Kelly Is white is $1.80. Sheboygan $1.70. New York quotes hydrated lime "on cars" in paper sacks, lump lime "alongside dealers docks" or "on cars."

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, f.o.b. exclusive of bags:

	May 1	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	1.80	1.50
Cincinnati (Utica)	1.72	1.72
Boston (Rosendale)	*2.60*	2.60
St. Louis (Carney)	*1.95*	1.75
Birmingham (Magnolia) pozzolan cement	2.10	....

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	May 1	One Month Ago	One Year Ago
New York, del. by truck	$2.50@2.60	$2.50@2.60	$2.70@2.80
New York, alongside dock to dealers	2.15	2.15	2.30
Jersey City	2.33	2.33	2.48
Boston	*2.63*	2.65	2.80
Chicago	2.20	2.20	2.20
Pittsburgh	2.19	2.19	2.24
Cleveland	2.39	2.39	2.46
Detroit	2.40	2.40	2.47
Indianapolis	2.41	2.41	2.41
Milwaukee	2.35	2.35	2.37
Duluth	2.19	2.19	2.14
Peoria	2.37	2.37	2.41
Cedar Rapids	2.40	2.40	2.48
Davenport	2.39	2.39	2.43
St. Louis	**2.30**	2.20	2.35
San Francisco	2.61	2.61	2.71
New Orleans	2.40	2.40	3.30
Minneapolis	2.42	2.42	2.39
Denver	2.84	2.84	2.85
Seattle	2.90	2.90	2.90
Dallas	2.05	2.05	2.25
Atlanta	2.35	2.35	3.10
Cincinnati	**2.47**	2.47	2.54
Los Angeles	3.00	3.00	3.40
Baltimore	2.50	2.50	3.05
Birmingham	2.65	2.65	2.50
Kansas City	2.27	2.27	2.42
Montreal	2.72	**2.72**	2.68
Philadelphia	2.41	**2.41**	2.41
St. Paul	2.42	2.42	2.39
Toledo	**2.45**	2.40	2.48

NOTE—Bags 10c. each, 40c. per bbl.; 20c. each in Canada, 80c. per bbl.

Current mill-prices per barrel in carload lots, without bags, to contractors:

Buffington, Ind.	$1.95	Hudson, N. Y.	$2.05
Universal, Pa.	1.95	Leeds, Ala.	1.95
Steelton, Minn.	2.00	Hannibal, Mo.	**2.05**
Fordwick, Va.	2.05	Lehigh Valley District	1.95
Mitchell, Ind.	**2.05**	Wyandotte, Mich.	2.15
Iola, Kan.	1.95	Alpena, Mich.	2.00
Mason City, Ia.	2.00	Richard City, Tenn.	2.05
La Salle, Ill.	**2.05**	Kingsport, Tenn.	2.05

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Warehouse: Pittsburgh Mill	Chicago Mill	New York	St. Louis	Dallas	San Francisco
032	22	$0.95	$1.02	$1.24	$1.04	$1.12	$1.21
049	28	1.20	1.30	1.58	1.32	1.38	1.52
065	35	1.47	1.59	1.94	1.62	1.67	1.87
093	45	1.89	2.04	2.50	2.08	2.00	2.42
124	57	2.34	2.53	3.09	2.59	2.55	3.07
153	68	2.79	3.02	3.60	3.08	3.15	.....
180	78	3.20	3.47	5.22	3.54	3.47	.....
245	103	4.22	4.57	4.60	4.66	4.58	.....
287	119	4.88	5.28	6.44	5.39	5.26	6.25
336	138	5.66	6.13	7.39	6.25	6.11	.....
395	160	6.56	7.10	8.67	7.25	7.12	.....

PAVING

034P	17	$0.72	$0.78	$0.95	$0.79	$0.76	.....
053P	24	1.02	1.10	1.35	1.12	1.07	.....
072P	31	1.29	1.40	1.71	1.42	1.39	.....
097P	40	1.66	1.80	2.20	1.83	1.90	.....
049R	24	....	1.10	....	1.12	1.07	.....
067R	31	....	1.40	....	1.42	1.39	.....
089R	40	....	1.80	....	1.83	1.90	.....

In rolls, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in. wide x 150 ft. long, or 600 sq. ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Weight in pounds	New York	Chicago	St. Louis	San Francisco	Dallas
2.2	$22.00	$19.00	$20.00	$19.00	$25.50
2.5	22.00	21.00	21.00	21.50	27.58
2.8	22.00	22.50	24.50	.....	30.71
3.0	24.00	24.50	26.50	23.00	33.16
3.4	27.00	26.50	29.00	.....	35.10

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Warehouse, Uncut: Pittsburgh Mill	Birmingham Mill	New York	Chicago	St. Louis	Dallas	San Francisco
½ and larger	$2.25@2.40	....	$3.49	$3.20	$3.35	$3.38	$3.65
⅜	2.30@2.45	....	3.59	3.25	3.45	3.43	3.75
¼	2.35@2.50	....	3.69	3.30	3.55	3.48	3.85
⅛	2.50@2.65	....	3.89	3.45	3.75	3.63	4.05
⅛	2.75@2.90	....	4.49	3.70	4.35	3.78	4.65

For size and cutting extras, manufacturers and distributers, see bar card of July 1, 1923.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
½ and larger	$2.30	$3.05	$3.08	⅛	$2.70	$3.30	$3.30
⅜	2.40	3.10	3.13	¼	3.30	3.50	3.48
⅛	2.50	3.15	3.18	.....	.....	.....	.....

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: May 1	One Month Ago	One Year Ago	Paving Block: 3-inch*	4-inch*
New York (del.)	$23.65	$23.65	$23.50	$46.50	$53@54
New York (at dock)	20.00	20.00	20.00	.....	.....
Chicago	11.00	11.00	11.00	34.00	42.00
St. Louis, salmon	16@18	16@18	15@17	38@40	40@42.50
Denver, salmon	12.00	12.00	12.00	.....	.....
Dallas	14.10	13.60	13.10	35.00	.....
San Francisco	15.50	15.50	15.00	.....	.....
Los Angeles	14.50	14.50	15.00	(not used)	
Boston (del.)	22.00	21.50	22.00	49.00	57.00
Minneapolis (del.)	15.00	14.50	17@19	.....	.....
Kansas City	16.50	16.50	15.50	(no market)	
Seattle	15.00	15.00	13.00	.....	58.50
Cincinnati	17.00	17.00	18.00	40.00	45.00
Montreal	17.50	17.50	16.50	100.00†	68.00
Detroit (del.)	17.50	17.50	17.50@20	38.50	41.50
Baltimore	18.00	21.00	23.00	40.00	45.00
Atlanta	12.00	12.00	14.00	40.00	45.00
New Orleans	19.50	18.75	17.25	.....	.....
Birmingham	12.50	12.50	12.50	.....	.....
Philadelphia	21.00	21.00	19@25	38.00	46.00
Pittsburgh (del.)	16.00	16.00	16.00	.....	.....
Cleveland	16.00	16.00	16.00	.....	.....

*For paving blocks 3½x8½x3 and 3½x8½x4 respectively. †Imported.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York: May 1 on Trucks*	New York: One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory*
4x12x12	$0.1162	$0.1573	$0.064	$0.125	$0.078	$0.108	.....
6x12x12	.1743	.2097	.088	.....	.106	.156	.....
8x12x12	.2179	.2621	.12	.215	.14	.244	.....
10x12x12	.....	.....	.1511	.....	.165	.....	$0.2786
12x12x12	.....	.....	.176	.....	.21	.....	.3448

*5 per cent off for cash.

	4x12x12	8x12x12	12x12x12
Boston	$0.125	$0.23	.....
Minneapolis (f.o.b. cars)	07	.12	$0.20
Minneapolis (delivered)	075	.13	.21
Cincinnati	.07485	.13745	....
Kansas City	.086	.158	....
Denver	.065	.123	.188
Seattle (delivered)	.11	.25	.36
Los Angeles	.0931	.1686	....
New Orleans	.14	.23	....
Detroit (delivered)	.1044	.1958	.2737
Montreal	.12	.225	.30
Baltimore	.125	.27	.....
Atlanta	.091	.1516	.....
Dallas	.11	.20	.285
Birmingham	.11	.18	.....
Pittsburgh (delivered)	.068	.128	.179
Cleveland	.08	.164	.....

San Francisco and New York quote on hollow partition tile.

STRUCTURAL MATERIAL—Following are base prices f. o. b. mill, Pittsburgh and Birmingham, together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh Mill	Birmingham Mill	Warehouse: New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in	$2.25@2.50	....	$3.59	$4.40	$3.45	$3.30	$3.60
Channels, 3 to 15 in	2.25@2.50	....	3.59	4.40	3.45	3.30	3.60
Angles, 3 to 16 in., ¼ in. thick	2.25@2.50	....	3.59	4.40	3.45	3.30	3.60
Tees, 3 in. and larger	2.25@2.50	....	3.59	4.40	3.50	3.30	3.60
Plates, ¼ in. thick and heavier	2.20@2.50	....	3.59	4.40	3.45	3.30	3.60

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Warehouse: Pittsburgh Mill	New York: May 1	New York: One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
½ in.	$2.65@2.75	$4.40	$4.00	$3.75	$3.90	$5.00	$4.90

CONE HEAD BOILER

½ in.	$3.15@3.25	$4.50	$4.10	$3.85	$4.10	$5.20	$5.00
⅝ and ¾	3.30@3.40	4.66	4.26	4.00	4.45@4.70	5.35	5.15
⅞ and 1	3.55@3.65	4.90	4.50	4.25	4.85	5.60	5.40

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$3.00	$3.80	$4.10	$4.55	$3.34	$4.95
Cut	3.15@3.25	4.45	5.25	5.75	3.59	5.00

SHIP SPIKES—Current prices per 100 lb.:

In.	San Francisco: Galv.	San Francisco: Black	Seattle Black
½	$8.25	$6.20	$7.75
⅜	7.80	5.80	5.78
½	7.65	5.15	5.35

Pittsburgh base in lots of 200 kegs or more, $3.25@3.50.

PREPARED ROOFINGS—Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $2.71 per roll to consumers in less than carload lots f.o.b. Philadelphia.

Single shingles, red and green slate finish, cost $6.95 per square (sufficient to cover 100 sq.ft.) in less than carload lots, f.o.b. Philadelphia. Strip shingles (4 in 1) f.o.b. Philadelphia, l.c.l., $6.10 per square.

ROOFING MATERIALS—Prices f.o.b. New York, to consumers in less than carload lots:

Tar felt (14 lb. per square of 100 sq.ft.) per ton	$85.73
Tar pitch (in 400-lb. bbl.), per 100 lb	2.13
Asphalt roofing (in barrels), per ton, f.o.b. plant*	40.50
Asphalt felt (light), per ton, f.o.b. plant*	87.75
Asphalt felt (heavy), per ton, f.o.b. plant*	87.75

*Delivered in Metropolitan Dist., $2.00 additional.

WINDOW GLASS—United inches, 25, bracket size 6x8 to 10x15, single thickness "AA," 82 per cent; "A," 86 per cent; "B," 88 per cent. Double thickness "AA," 82 per cent; "A," 85 per cent; "B," 88 per cent discount from jobbers list at New York warehouses.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	$2.85@3.00	$4.10	$4.00	$5.00	$4.34
No. 12	2.95@3.05	4.15	4.05	5.05	4.39
No. 14	3.05@3.15	4.20	4.10	5.10	4.44
No. 16	3.25@3.35	4.30	4.20	5.20	4.54
Black					
*Nos. 18 and 20	3.70	4.80	4.55	5.60	4.65
*Nos. 22 and 24	3.75	4.85	4.55	5.65	4.70
*No. 26	3.80	4.90	4.60	5.70	4.75
*No. 28	3.85	5.00	4.70	5.80	4.85
Galvanized					
No. 10	3.90@4.00	5.00	4.60	5.50	4.90
No. 12	4.00@4.10	5.10	4.70	5.60	5.00
No. 14	4.00@4.10	5.10	4.70	5.60	5.00
Nos. 17 to 21	4.30@4.40	5.40	5.00	5.90	5.30
Nos. 22 and 24	4.40@4.50	5.55	5.15	6.05	5.45
*Nos. 25 and 26	4.50@4.60	5.70	5.30	6.20	5.55
*No. 28	4.80@5.00	6.00	5.60	6.50	5.85

*For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon:

	New York: May 1	New York: One Year Ago	Chicago: May 1	Chicago: One Year Ago
Raw in barrels (5 bbl. lots)	$0.95	$1.16	$0.94	$1.25

WHITE AND RED LEAD—In 100-lb. kegs, base price in cents per pound:

	Dry		In Oil	
	May 1	1 Yr. Ago	May 1	1 Yr. Ago
Red	15.00	14.50	16.50	16.00
White	15.00	14.50	15.00	14.50

LUMBER

Prices wholesale, per M. ft. b.m., to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to dealers at yards. To contractors, $2 per M. ft. additional.

	6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft	25 to 32 Ft.
3x3 and 4	$35.00	$36.00	$37.00	$40.00
3x6 and 8	35.00	36.00	37.00	40.00
4x4-6 and 8	35.00	36.00	37.00	40.00
3x10 and 12	35.00	36.00	37.00	40.00
3x14	39.00	39.00	41.00	43.00
4x10 and 12	35.00	36.00	37.00	40.00
4x14	39.00	39.00	41.00	43.00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft.
6x10	$37.00	$39.00	$41.00
6x14	38.00	40.00	42.00
8x10	37.00	39.00	41.00
8x14	38.00	40.00	42.00

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine.

	New York*		Chicago	
	20 Ft. and Under	22-24 Ft.	20 Ft. and Under	22-24 Ft.
3x4 to 8x8	*$46.00*	*$47.00*	*$41.50*	*$43.50*
3x10 to 10x10	*51.00*	*52.00*	*46.50*	*48.50*
3x12 to 12x12	*58.00*	*59.00*	*53.50*	*55.50*
3x14 to 14x14	*64.00*	*65.00*	*59.50*	*61.50*
3x16 to 16x16	*72.00*	*73.00*	*68.50*	*70.50*
3x18 to 18x18	.....	.....	*77.50*	*79.50*
4x20 to 20x20	.....	.....	*86.50*	*88.50*

*Wholesale price to dealers; to contractors, delivered from lighters or cars to job, $5 additional. Short leaf pine costs $3 per M. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12 x 12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under.

Other Cities	8x8-In. x 20 Ft. and Under				12x12-In. 20 Ft. and Under	
	P.	Fir*	Hemlock	Spruce	P.	Fir*
Boston	*$57.00*	*$66.00*†	*$51.00*	*$51.00*	*$73.00*	*$88.00*†
Seattle	.....	29.50	.....	.....	.....	*27.00*
New Orleans	30.00	.....	.....	.....	42.00	.....
Baltimore	*32.50*	*49.50*	**53.60**	60.00	38.00	*49.75*
Cincinnati	40.00	74.00	74.00	88.00	44.00	78.00
Montreal	50.00	58.00	.....	.....	.....	65.00
Los Angeles	.....	49.00	.....	.....	.....	50.00
Denver	.....	40.75	40.75	40.75	.....	**49@53**
Minneapolis	42.00	*41.75*	40.00	.....	45.10	*42.75*
Atlanta	36.00	.....	.....	.....	40.00	.....
Dallas	55.00	.....	.....	.....	60.22	.....
Kansas City	43.50	48.50	.....	.....	54.50	49.50
Birmingham	25@28	.....	.....	.....	29@32	.....
Philadelphia	*48.00*	42.00	43.50	48.00	*59.00*	43.00
Detroit	38.75	48.75	.....	.....	58.75	48.75
St. Louis	42.00	.....	.....	.....	54.00	.....

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir*	Hemlock	P.	Fir*
Boston	*$47.00*	$52.00†	$45.00	*$55.00*	*$60.00*†
Seattle	.....	25.00	.....	.....	29.00
New Orleans	72.00	.....	.....	34.00	.....
Baltimore	*55.00*	44.00	44.00	34.00	50.00
Cincinnati	75.00	80.00	75.00	38.00	88.00
Montreal	56.00	50.00	45.00	45.00	45.00
Los Angeles	.....	49.00	.....	.....	.....
Denver	.....	35.25	35.25	.....	32.75
Minneapolis	45.00	*37.25*	36.50	39.00	*34.25*
Atlanta	24.00	.....	.....	34.00	.....
Dallas	55.00	.....	.....	58.66	.....
Kansas City	80.50	46.00	.....	77.50	.....
Birmingham	21@23	.....	.....	29@33	.....
Philadelphia	*32.00*	42.00	43.00	*49.00*	41.00
Detroit	43.25	39.00	.....	45.50	41.00
St. Louis	41.00	.....	.....	30.00	.....

Birmingham—Quotes carload lots, f.o.b. sidings; $4.00 additional per M.ft. to contractors.

Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.

Denver—Quotes dealers price to contractors on large projects.

St. Louis—Wholesale price to contractors, f.o.b. cars, $3 per M.ft. additional.

Seattle—Price to contractors, delivered.

Dallas—Wholesale to contractors, $10 per M.ft. additional.

*Douglas fir. †Prime.

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.14½	$0.18½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.19	.23½
12 in.—2 ft. from butt	6 in.	60 to 69 ft	.21½	.25½
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.25½	.34
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.27½	.36½
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	.35	.41

MISCELLANEOUS

STEEL SHEETPILING—The following price is base per 100 lb. f.o.b. Pittsburgh, with a comparison of a month and a year ago:

May 1	One Month Ago	One Year Ago
$2.40@2.50	$2.65	$2.60@2.75

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Hercules red strand, all constructions	20%
Patent flattened strand, special steel wire rope	20%
Patent flattened strand, iron rope	5%
Plow steel round strand rope	35%
Special steel round strand rope	30%
Cast steel round strand rope	20%
Round strand iron and iron tiller	5%
Galvanized steel rigging and guy rope	7½%
Galvanized iron rigging and guy rope	+12½%

California, Oregon, Nevada and Washington Discount: 5 points less than discount for Eastern territory.

Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.

Arizona: Discount 10 points less than discount for Eastern territory.

Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.

North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ½-in., 8 ft., ⅝-in., 6; ¾-in., 4½; 1-in., 3½; 1¼-in., 2 ft. 10 in.; 1½-in., 2 ft. 4 in. Following is price per pound for ½-in. and larger, in 1200-ft. coils:

Boston	**$0.17½@.22**	New Orleans	$0.17½
New York	.19½	Los Angeles	.20
Chicago	.18	Seattle	.18
Minneapolis	.19½	St. Louis	.18½
San Francisco	.17	Montreal	.22
Atlanta	**.24**	Detroit	.20
Denver	.19½@20½	Baltimore	.18
Cincinnati	.21	Kansas City	.19½
Dallas	.21	Birmingham	.20½
Philadelphia	**.18**		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.27	$0.295
Boston	.23	.25
Kansas City	.2275	.2475
Seattle	.165	.19
Chicago	.22	.25
Minneapolis	.1917	.2123
St. Louis	.22	.245
Denver	.2025	.2475
Dallas	.225	.302
Los Angeles	*.1925*	.2225
Atlanta	.23	.255
Baltimore	.22	.23
Cincinnati	.2125	.2325
Montreal	.195	.235
Birmingham, *delivered*	.16	.17
New Orleans	**.235**	**.29**
San Francisco	.1625	.1925
Philadelphia	.215	.24

CHEMICALS—Water and sewage treatment chemicals, spot shipments in carload lots, f. o. b. New York:

Sulphate of aluminum, in bags, per 100 lb.	$1.40@1.50
Sulphate of copper, in bbl., per 100 lb.	**4.90@5.00**
Soda ash, 58%, in bags, per 100 lb.	1.25@1.45
Chlorine, liquid, cylinders, 100 lb., per lb. (f.o.b works)	.05½@.07½
Hypochlorite of lime (bleaching powder) in drums, per 100 lb.	2.25@2.35

FREIGHT RATES—On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanised wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Baltimore	$0.31	Detroit	$0.29
Birmingham	.58	Kansas City	.735
Boston	.365	New Orleans	.67
Buffalo	.265	New York	.34
Chicago	.34	Pacific Coast (all rail)	1.15*
Cincinnati	.29½	Philadelphia	.32
Cleveland	.215	St. Louis	.43
Denver	1.15*	St. Paul	.60

* Minimum carload, 50,000 lb., structural steel only; 80,000 lb., for other iron or steel products.